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DESIGN OF AN OFFICER ASSIGNMENT AND CAREER PLANNING DECISION SUPPORT SYSTEM FOR ELECTRONIC SECURITY COMMAND

THESIS

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THESIS

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Preface

In my personal opinion, the Air Force needs to make some major changes to the officer resource management system. Presently, officer job assignments are made under the prevailing philosophy of providing officers with a broad base of experience which the Air Force feels is a prerequisite for senior officer positions. Since only about 8 percent of all officers are promoted to the rank of colonel, I question if this is the best officer management philosophy for the majority of Air Force officers. In this thesis, I present an alternative approach to officer assignments and career management.

Although this thesis presents a decision support system (DSS) design for the Electronic Security Command (ESC), the concepts directly apply to all Air Force Major Command (MAJCOM) and the Military Personnel Center (MPC) officer resource management systems. I hope this study provides ESC with a good foundation for the development of their DSS and gives MPC some food for thought.

I would like to thank several individuals: my advisor, LtCol "Skip" Valusek, for his patience and direction throughout this effort and particularly for his encouragement during the days when I seriously contemplated looking for a new thesis topic; my reader, Dr. Yupo Chan, for his advice and counsel throughout this project; and Capt Alan Chubb and all the individuals at HQ ESC for their assistance and cooperation in making this thesis effort possible. Most of all, I wish to express my gratitude to my wife, [redacted] and my children, [redacted] their faithful support, patience, and understanding over the past six months.

Richard A. Paulsen

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Abstract

This thesis presents a decision support system (DSS) design for the Electronic Security Command (ESC) officer resource managers. The DSS design provides resource managers with:

1. Quick access to officer and job data bases needed to support the numerous phone calls from officers seeking assignment information.
2. A computerized notepad for documenting phone conversations and other various pieces of information gathered on each officer.
3. A rule-based career model to evaluate an officer's career progression and offer assignment recommendations and career counseling advice.
4. A method for scoring officers for jobs based on each officer's qualifications and career development needs.
5. A linear programming assignment model which provides job assignment recommendations by maximizing the sum of officer job qualification scores.

The technique of concept mapping was used to bound the problem and elicit system requirements from ESC. A set of screen-display storyboards were constructed to communicate system requirements in the form of representations, operations, memory aids, and control mechanisms (ROMC). Methodologies for characterizing and eliciting job requirements, evaluating officer career needs, and evaluating officer qualifications for jobs were also developed. Goal programming and point estimate weighted-sums models were also presented as possible alternatives for an assignments model.

This thesis laid the foundation of requirements determination, methodology development, system design, and model formulation upon which

ESC can now begin building a DSS that will help resource managers make officer assignment decisions based on the "best qualified" officers for each job, while also considering the career development needs of each officer and the future force requirements of ESC.

DESIGN OF AN OFFICER ASSIGNMENT AND CAREER PLANNING DECISION SUPPORT SYSTEM FOR ELECTRONIC SECURITY COMMAND

I. Introduction

Air Force Assignment Guidelines

> The primary objective of the officer assignment system is to assign Air Force officers to enhance the effective and sustained mission accomplishment. The professional development of highly qualified officers to meet the needs of the Air Force is an important corollary. (AFR 36-20, 1988:8)

Resource managers are the central focus of the officer assignment system. They have the tough job of trying to assign the most qualified officers to current and projected job vacancies to insure effective sustainment of the Air Force mission while also trying to select the right assignment for each officer that will enhance his/her professional training and development for future assignments in the Air Force. Assignment decisions are made based on each officer's assignment history, experience, and career broadening needs; current requirements; and the resource manager's subjective perception of the effect of a particular assignment on the officer's future promotion potential (McCurdy, 1988).

Military Personnel Center (MPC) resource managers have the responsibility for making all officer assignments. The decision process involved in matching officer resources to job requirements involves sorting through numerous inputs such as: 1) policies and procedures contained in Air Force Regulations; 2) by-name requests submitted by MAJCOMs; 3) individual officer career objectives and commander/supervisor recommendations on the Officer Career Objective Statement (Air Force

Form 90); 4) officer qualifications and professional development; and 5) Air Force requirements (Washborn, 1988). Air Force requirements include such things as insuring an equitable distribution of officer specialties and grades across all MAJCOMs, particularly in the mission support and non-rated operation specialty areas, as well as assigning officers to joint and departmental activities (AFR 36-20, 1988:8). "The primary consideration in the assignment selection process is the officer's current and potential qualifications to fill a valid requirement and the nature of the requirement." When all officers with the required qualifications are identified, other factors are considered, but the primary discriminator is an officer's time-on-station (TOS) or date eligible for return from overseas (DEROS) (AFR 36-20, 1988:50).

Air Force Career Management Guidelines

> The primary purpose of career management is to prepare an officer to assume additional responsibilities within the defense establishment. A secondary purpose is to prepare each officer for advancement. (AFR 36-23, 1985:9)

Each individual officer has "ultimate responsibility for his or her own career" (AFR 36-23, 1985:17). In deciding on career objectives an officer needs to consider duty performance, variation of assignments, professional military education (PME), academic education, technical training, and self development. AFR 36-23 provides a 30-year career progression guide for each officer specialty area in the form of milestone charts broken down into five specific phases. Additional career guidance is available in AFR 36-1, which describes officer qualifications, duties, and responsibilities associated with each specific AFSC (AFR 36-1, 1984). Informal career guidance is provided by AFRP 36-1,

Officer's Career Newsletter and the MPC Hotline. Additionally, each base CBPO maintains a microfiche Officer Authorization List which contains a listing of all Air Force officer jobs sorted by AFSC, base, and rank. (Bailey, 1988)

Air Force officers make their career objectives known by submitting an Officer Career Objective Statement (Air Force Form 90) to their Major Command (MAJCOM) and MPC resource managers. Officers are encouraged to consider promotion board criteria in their career objectives:

> Board members use the whole person concept to subjectively assess each eligible officer's relative potential to serve in the next higher grade. The whole person concept includes such factors as performance, leadership, professional competence, breadth of experience, job responsibility, academic and professional education, and specific achievements. (AFR 36-23, 1985:6.1)

To aid in this process, supervisors are identified as being "in the best position to determine the career development needs of their subordinates" (AFR 36-23, 1985:17). A recent revision to AFR 36-23 requires the review of an officer's Air Force Form 90 by that officer's commander/supervisor.

Although HQ USAF provides overall guidance for officer careers, each MAJCOM is "responsible for ensuring that adequate career development programs are set up." Guidelines for these programs come from "career management concepts, processes, techniques, and programs" defined by HQ USAF. (AFR 36-23, 1985:16)

MPC is given primary responsibility in the implementation of career management. This is done through the assignments process. "Assignment goals are to fulfill present and projected authorizations, manage available personnel resources at the lowest cost, meet mission re-

quirements, and provide full career progression opportunities" (AFR 36-23, 1985:11).

General Background

Under the current system, officer assignments are commonly made by finding an officer who is eligible for permanent change of station (PCS) based on sufficient TOS or DEROS and matching his/her rank, Air Force Specialty Code (AFSC), and educational degree code to a vacant job requirement. Although this method results in filling all positions, it does not effectively incorporate officer career management nor optimally match officer qualifications with job requirements, and is not "the best way to assign people to professionally develop the force" (HQ ESC, 1988b).

Aside from the Personnel Data System (PDS), there is very little automation of the present assignments system. Resource managers must manually browse through large amounts of data such as: 1) Air Force Regulations; 2) by-name requests; 3) individual officer career objectives and commander/supervisor recommendations on the Air Force Form 90; 4) officer personnel data; 5) job requirement data; 6) Officer Effectiveness Reports (OERs); 7) lists of officers due for PCS; 8) lists of officers eligible for overseas short and long tours; and 9) lists of vacant and soon to be vacant jobs created by PCSs, retirements, and service resignations.

Being the central focus for Air Force officer assignments, MPC resource managers are responsible for large numbers of officer resources and job requirements. For example, there are six Research and Development/Scientific resource managers who handle the over 9000 Air Force

26XX-28XX officers and job requirements. Even though these officer resources are divided alphabetically by specialty area, each resource manager is responsible for over one thousand officers and several thousand job requirements (Bailey, 1988). A resource manager's knowledge of individual officer experience and specific job requirements is severely limited by the information available in the PDS. The PDS does not provide a detailed assessment of an officer's background and technical expertise nor a detailed listing of desired qualifications for each job, both of which would be highly useful in obtaining a better officer/job match.

MAJCOM resource managers identify requirements and make assignment recommendations to their MPC counterparts. MAJCOM resource managers are not in a direct chain-of-command between MPC and individual officers and do not hold final assignment authority. Thus, more often than not, officers work directly with their MPC resource managers. Additionally, MAJCOM resource managers do not have direct access to information on personnel assigned to other MAJCOMs and must rely on MPC resource managers to determine what officer resources may be available outside their particular MAJCOM (McCurdy, 1988).

Specific Problem

The Electronic Security Command (ESC) is a MAJCOM comprised of approximately 1000 officers, 12,000 enlisted, and 1000 civilians stationed at over 90 locations around the globe. ESC faces some specific force development problems which are presented in Table 1.1. ESC has initiated a Force Development Program to implement a long-term process to select, educate, train, and assign officer, enlisted, and civilian

TABLE 1.1

ESC Force Development Problems

Present ESC Problems

1. Experienced personnel are being lost - specifically 2825s
2. Jobs are not being filled with the best-qualified individuals
3. An automated force management system to help insure the development of a highly-qualified pool of experienced individuals for future ESC requirements does not exist

Resource Manager Problems

1. Resource managers are inundated with phone calls
2. Specific job requirements do not exist
3. Personnel skills and qualifications are not well documented
4. A system that trades-off assignment criteria such as: what is best for a person's career, best for mission accomplishment, and best for developing skills for future ESC force requirements does not exist
5. Some personnel are assigned the job of resource manager without any prior personnel experience
6. Resource managers must manually browse lists, requirements, records, and regulations
7. ESC resource managers are not granted access to PDS personnel information for personnel currently serving in other MAJCOMs
8. Resource managers have a difficult time describing the decision process for making assignments

Officer/Supervisor Problems

1. Specific Career Guidance is not available for career management, assignment projection, and career counciling
2. Specific assignment information is not available for filling out the AF Form 90 and career planning

personnel to meet the requirements of advancing technology (ESCR 530-1, 1988:1). The following discussion focuses on these issues from the perspective of the command, the resource manager, and the individual officer. Some possible solutions to these problems, based on initial discussions with ESC personnel, are listed in Appendix A.

Command Perspective. ESC's officer ranks are composed of approxi-

mately 430 80XX Intelligence Officers, 240 49XX Communications Officers, and 210 26XX-28XX Scientific/Research and Development Officers. While ESC is a major employer of Air Force Intelligence Officers, it has only 3% of all the Air Force 26XX-28XX authorizations, the majority of which are 2825 Electrical Engineers. After a tour in ESC, MPC typically assigns these 2825s to other MAJCOMs, from which they rarely return on subsequent assignments. The ESC Commander desires to curtail this loss of valuable experience by utilizing these ESC-trained assets for follow-on or future tours in ESC (Chubb, 1988b).

The primary objective of the ESC Force Development Program is to "develop a force of multiskilled individuals who are technically and professionally prepared to employ advancing technology" (ESCR 530-1, 1988:1). To assist in this effort, the Office of Force Development (ESC/DPQ) was established and tasked with the responsibility of developing an Automated Force Planning System (AFPS) to "support command force modeling, analysis, simulation, projection, and professional development planning efforts" of ESC's officer, enlisted, and civilian force (ESCR 530-1, 1988:7).

DPQ is taking a two-leveled approach to the AFPS. First, they are designing a quick reaction capability Tracker-Planner Automated System (TPAS) to support functional management activities. The TPAS will consist of several data base files, the most important of which will contain the experience and training of all ESC personnel and the specific job requirements of all critical ESC positions using an ESC-designed coding system. The TPAS will provide the basic foundation for a better personnel/job match by considering specific job qualifications and per-

sonnel experience (HQ ESC/DPQ, 1988a). Second, DPQ is planning to develop the capability of projecting future mixes of personnel and skills based on current manning, retention, training, and assignment policies through the use of a simulation model. This capability will enable ESC to detect potential manning problems early enough to make necessary changes in career management policies and help ensure an adequate pool of highly qualified personnel is available to meet future ESC needs (HQ/DPQ, 1988b).

In addition to building the AFPS, ESC/DPQ desires to implement a system that will allow resource managers to do a better job of matching personnel skills to job requirements. In some cases, this may require choosing the best qualified individual for an assignment in order to maximize mission performance. In other cases this may mandate the selection of a less qualified individual for a job in order to develop a particular skill or experience needed for future ESC assignments (Chubb, 1988b).

Personnel Management Perspective. There are 15 resource managers assigned to ESC/DPR: 3 officer resource managers handle 40 officer AFSCs and 12 enlisted resource managers handle 43 enlisted AFSCs. Two of the officer resource managers are noncommissioned personnel specialists and the third is an intelligence officer with no personnel background. Enlisted resource managers serve a 3-4 year tour, and officer resource managers serve a 2-3 year tour. The shorter tour served by officers creates two problems:

1. It may take as long as a year for a newly assigned officer without previous personnel experience to achieve a good working knowledge of personnel system regulations, assignment procedures, and establish a good working relationship with MPC.

2. A resource manager's most important product is a "sellable" assignment recommendation to MPC. Many assignments are worked based on the rapport between resource managers. The 80XX Intelligence Officer Resource manager has 5 MPC counterparts. Whenever one of these individuals PCSs, any verbal or standing agreements will most likely be lost (McCurdy, 1988).

In addition to working closely with the MPC resource managers, the ESC resource managers work closely with functional-manager representatives, who are individuals within ESC headquarters that "represent functional managers on force management and development matters" for their particular specialty area. There are 12 functional managers who are assisted by 46 functional-manager representatives at HQ ESC. Functional-manager representatives make personnel assignment recommendations to ESC resource managers and review all MPC final assignment decisions (Chubb, 1988a).

ESC resource managers spend an enormous portion of their day on the telephone and do not have an automated system to document conversations with individual officers, provide easy access to the PDS and job requirements data, and aid in the assignments decision process. Resource managers take notes on each individual phone call and later file them in folders. To obtain PDS information on an officer phoning for assistance, the resource manager must place the individual on hold and then print out an Assignment Processing Single Unit Retrieval Function (SURF) which may take as long as 5 minutes. Other information is contained on monthly printouts of various data base information such as the manning roster, the short tour return date (STRD) list, and overseas duty selection date (ODSD) list (McCurdy, 1988).

Officer/Supervisor Perspective. Air Force regulations have given ultimate career management responsibility to each officer, and defined

each supervisor as being the best individual to determine subordinate career development needs. Although AFR 36-23 provides general career guidance and the Officer Authorization list provides a general idea of what jobs exist, officers and supervisors are not provided the two essential inputs necessary for career management: a specific career plan and information concerning what jobs are available. There are three ways for an officer to determine what jobs will be available during the period of time that he/she is eligible for re-assignment: 1) sending out resumes to units the officer would like to work for; 2) calling MAJCOM and MPC resource managers; and 3) probing for information using personal contacts.

Scope

Several discussions were held with ESC personnel in an attempt to define a portion of the ESC force development problem that would be doable within the time constraints of a thesis. Several discussions focused around whether the thesis should concentrate on how to solve the loss of 2825 officers, over which ESC has relatively no control, or how to make assignments and career management decisions for personnel over which ESC has much greater control. DPQ felt that ESC should be able to fill all critical 2825 jobs by formally defining which jobs require individuals with prior ESC experience and working with MPC to fill those jobs with experienced officers. DPQ suggested that the thesis should concentrate on developing a tool that would aid the resource managers in choosing the "best qualified" individuals for each job while also considering the career needs of the individual and the future force requirements of ESC. In order to further reduce the size of the problem,

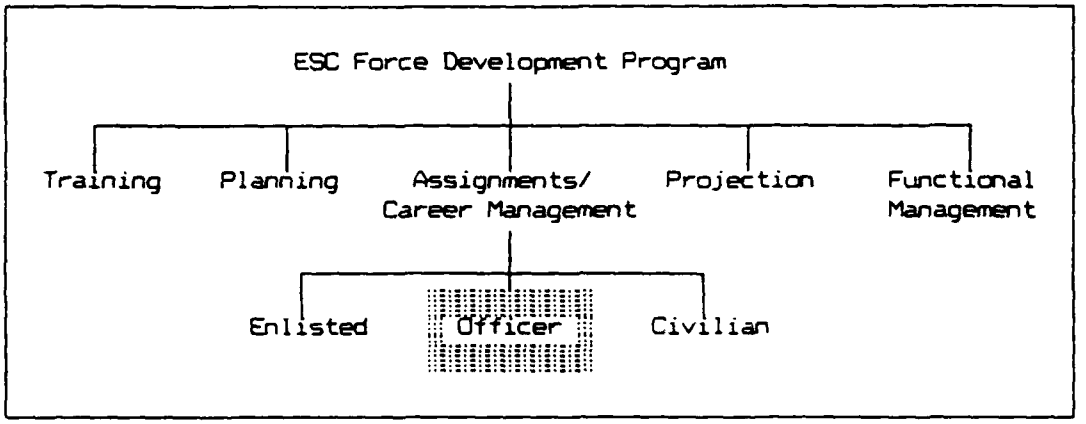


Figure 1.1 Thesis Contribution to the ESC Force Development Problem

DPQ recommended that the effort concentrate on the design of a decision aid for the ESC/DPRO Officer Resource Managers. Figure 1.1 is a hierarchical diagram showing where the proposed research effort fits into the ESC Force Development Program.

Research Question

The following question defined the emphasis of this research effort:

> Given the current state of the ESC officer assignment system, what improvements can be made by incorporating officer qualifications, specific job position requirements, and an officer career development plan into the assignment decision process, and to what degree will these improvements impact the filling of jobs with the "best qualified" officers and the building of a pool of well-qualified officers with the proper mix of skills to meet the future needs of ESC?

Subsidiary Questions

In order to answer the main research question, the following subsidiary questions were addressed:

1. What specific officer qualifications should be considered when making an assignment?

2. What specific job position requirements are essential for correct screening of potential job candidates?

   a. Are there specific ESC jobs that require previous ESC job experience?

   b. Will there only be a minimum level of experience identified for each job or will there be desired levels of experience stated as well?

3. What are the essential elements of an ESC officer career development plan for ESC ?

   a. Are officers to be managed by AFSC or by an ESC-defined specialty area?

   b. How will ESC's career plan affect officers who transfer into ESC from other commands who may be under a different MAJCOM level career development plan?

4. What does/will the ESC officer pool consist of?

   a. Will the pool be composed of strictly ESC resources, and if not, are specific officers "tagged" as an ESC resource while serving on tours outside of ESC?

   b. Is the ESC officer pool actually a set of smaller pools, each with their own specialty track?

   c. If the ESC officer pool is actually a set of smaller pools, should certain officers be managed for future command opportunities while others are managed for specific technical specialty areas?

5. Can an assignment policy be defined that picks the "best person for the job" while developing skills and experience for ESC's future force requirements and providing enough career broadening to ensure promotability?

   a. What is the best way to trade off "best qualified for the job" verses long-term development of the force?

   b. Can the decision process used in assigning officers (either descriptive or prescriptive) be captured in a rule based model?

   c. What elements and weighting factors would be necessary for a multi-criteria assignments model?

   d. Can a decision rule hierarchy be established that would allow a goal programming model to be used?

6. Should the decision aid focus on working a single officer into various assignment options, or seek to optimize a group of officers being considered for numerous assignments?

7. What computer resources and software would be of the greatest help in implementing a solution?

As a prelude to answering these questions, Chapter II presents some similar military personnel career management problems and some modeling techniques that have been used to solve them.

II. Approaches to Military Personnel Resource Management Problems

This chapter outlines career management problems encountered in four Air Force officer specialties which are similar to the ESC officer resource management problem. Current models and modeling techniques used for Army, Navy, and Air Force enlisted and officer personnel planning and decision making are also discussed.

Setting

"Clearly discernable trends indicate that the American military is moving from an institutional form to one more and more resembling that of an occupation" (Moskos, 1978:31). The former is characterized by "a purpose transcending individual self-interest in favor of a higher good," as opposed to the latter which is characterized by "priority of self-interest rather than that of the employing organization" (Moskos, 1978:31-32). An analysis of the 1977 and 1980 Quality of Air Force Life Surveys indicate that Air Force personnel shifted more toward an occupational orientation between 1977 and 1980. Captain Eric Tomlin recommended that the Air Force develop programs to re-institutionalize Air Force personnel and make necessary changes to help retain the more occupationally oriented individuals, who tend to separate from the Air Force in order to pursue specialized careers in the civilian sector. (Tomlin, 1988:102)

Rapid technological developments of the 1980s have been responsible for a significant shift in military personnel skills. "Complex weapons systems that demand high levels of expertise have created offi-

cer specialists more at home in the super-chilled computer rooms than battlefields" (Stewart, 1988:11). Air Force officers with scientific and engineering skills have become extremely specialized and are highly encouraged to pursue advanced academic degrees (AFR 36-23, 1985). The Air Force utilizes more officers in this capacity than do the other services and therefor faces an even greater problem of retaining these highly-skilled officers.

Similar Career Management Problems and Approaches

Major Harley MacLeod identified the lack of a single source reference document for Air Force intelligence officer career planning. His thesis effort focused on the development of a guidebook for junior Air Force intelligence officers. He also identified the major limitation of such a document:

> It is not, and cannot be, an answer book for there are no "right" answers. Each individual must find his own answers and make his own career decisions based upon his personal needs, desires, philosophy and goals as well as the opportunities available to him and those he makes for himself. (MacLeod, 1982:2)

In addressing the career planning of Military Airlift Command (MAC) pilots, Major Andrew Gessner stated, "an individual has nowhere to turn for solid career guidance. All the available career planning guidance is general in nature, vague, or somewhat confusing" (Gessner, 1986:iii). He identified the rescission of Air Force Pamphlet 36-6, Assignment Information Directory (AID), as a major contributor to the lack of clear career guidance (Gessner, 1986:2). Major Gessner also pointed out that AFR 36-23 develops career guidance for a 30-year career. Since only 8 percent of all officers make it to the grade of

colonel and many officers retire at the 20 year point, AFR 36-23 does not project a realistic career progression for the majority of Air Force officers (Gessner, 1986:5). The major objective of this report was to "convince MAC/DP to revisit the issue of career management and develop a single-source reference document for use by MAC pilots to aid in individual career planning." (Gessner, 1986:vii)

Major Billie Carpenter identified a unique approach to the career planning problem. He suggested the Air Force "identify our future leaders early, train them, and among the qualified, select the best to be tomorrows commanders." He stated that a career progression plan needs to be individualized "so both the Air Force and the individual will know where and how he stands as he progresses." He claimed this would enable an individual to "utilize his desires and talents, keep him motivated and challenged, and give him a sense of direction." (Carpenter, 1980:39)

Capt Frank Gorman approached the problem of identifying a logistics career development program by surveying 1840 active-duty Air Force logisticians. From the compiled survey results, he recommended the Air Force develop an initial core course for new logistics officers to improve their overall perspective of the logistics field, develop a program to allow for greater crossflow between logistic specialty areas, and "improve supervisor involvement in subordinate career development" through training and OER accountability. (Gorman, 1986:189)

Personnel Models

This section provides documentation on some of the models and modeling techniques used by military manpower organizations. The

references are merely a sampling and are by no means exhaustive. In fact, a Navy compendium listed over 200 manpower control and planning models that the services had developed by 1977 (Jaquette, 1977:v).

The Career Area Rotational Model (CAROM) was developed by the Air Force Human Resources Laboratory to "mathematically capture the interactions and interrelationships among manpower and personnel system variables and parameters" (Looper, 1978:3). Its purpose is to "investigate and analyze the possible effects of changes in force structure or changes in personnel policy parameters." The drawback of the model is that it "should not be used to actually assign or promote any individual nor to project the career progression of actual Air Force members." (Looper, 1978:7)

The Army Research Institute for Behavioral Science developed a personnel assignment model, the Career Strategy Longitudinal Evaluator (CASTLE) "to be used as an evaluative tool with which planners can ask 'what if' questions and explore the results or consequences of personnel management changes" (Van Nostrand, 1980:14). The model was specifically developed to "evaluate alternative policies designed to alleviate career management problems in the engineer officer specialty" (Van Nostrand, 1980:1). As such, "CASTLE does not actually assign officers" (Van Nostrand, 1980:11).

The Army developed the Military Occupational Specialty Level System (MOSLS) to "support programming and planning decisions in the areas of recruitment, training and education, promotion, reclassification and reenlistment, and separation and retirement" (Eiger, 1988:57). One purpose in developing this decision support system (DSS) was to

alleviate inconsistent recommendations from policy analysts using various models in the personnel strength planning community. MOSLS provides long-range projections of Army enlisted personnel broken out by pay grade and skill as well as making recommendations for meeting future personnel requirements. (Eiger, 1988:59)

The Headquarters Air Force Deputy Chief of Staff for Personnel is building a DSS, the Enlisted Force Management System (EFMS), to overcome deficiencies and enhance the capabilities of TOPCAT, the present enlisted force planning and programming system (Walker, 1986:1-2). The objectives for the EFMS were to: 1) support grade restructuring; 2) support personnel planning; 3) support personnel programming; and 4) coordinate, integrate, and unify the enlisted force planning, programming, and budgeting cycle (Carter, 1983:vii).

The Air Force Officer Assignments Model (AFOAM) was developed to analyze the constraints and effects of the Air Force System Command Acquisition Management Career Development Program on the numbers of officers meeting the education and experience requirements placed on future DOD senior acquisition managers by Congress (Polk, 1988:213). AFOAM captured the current assignments process at the "person/job level of detail and facilitated quantifying the impacts of the plan and its policy options on individual officers' careers" (Polk, 1988:218). AFOAM contains enough officer qualification and job requirement detail that it could be used as an assignment decision aid, although it was primarily designed to answer what-if policy questions (Weaver, 1988).

The Navy Personnel and Development Center developed a network flow model for the purpose of automating E-1 through E-3 Seaman assignments.

The model employs preemptive goal programming to allow decision makers to specify goal ranking. The model was accepted and implemented by the Navy's Enlisted Personnel Management Center. (Liang, 1986)

Omer Saatcioglu developed a multi-attribute assignment goal-programming model for selection and transfer of surplus personnel to vacant positions. This technique evaluates surplus individuals on the basis of attributes and seeks to meet a prioritized list of goal constraints. Although not currently employed by a military organization, he suggested that this technique could be used to make officer assignments. (Saatcioglu, 1987)

Summary and Conclusion

Air Force officers have become more occupationally oriented and have developed a higher degree of specialization over the past decade. There are fragmented attempts throughout the Air Force to consolidate career guidance for various career specialties into single source reference documents. These efforts suggest that future leaders need to be identified early in their careers and managed separately, while a more realistic 20-year career guide should be provided to the remaining majority of Air Force officers. These career plans should show an officer where he/she stands throughout career progression, plan for career broadening and crossflow, and involve each officer's supervisor in an advisory role.

Most of the models and modeling techniques employed in personnel systems focus on manpower issues. The two decision support systems being implemented in the Army and Air Force also focus on manpower issues. These DSSs employ models to answer what-if questions in order

to make policy decisions regarding the number of required personnel in each specialty area for programming and planning purposes. The Navy's seaman assignment model was the only model identified as having been developed to actually make assignments. From the information available, it does not seem that there has been any utilization of models to actually make officer assignments or plan officer careers. Neither does it seem that there has been any attempt to design a DSS to assist resource managers in making officer assignment decisions.

Decision support systems and the appropriateness of selecting a DSS approach for the ESC officer resource management problem is discussed in Chapter III.

III. Methodology

Decision Support Systems

Even though there have been numerous books and articles written about Decision Support Systems (DSS), a major problem in discussing DSS is the lack of a universally accepted definition. Definitions range from very general ones such as "any system that supports a decision" (Sprague, 1982:4) and "a system (automated or manual) that supports the cognitive processes of judgment and choice" (Valusek, 1988), to more formal definitions such as "an interactive system that provides the user with easy access to decision models and data in order to support semi-structured and unstructured decision-making tasks." Because of these definitional problems, "early DSS researchers such as Keen and Scott Morton tended to avoid definitions" and have "focused on DSS characteristics" (Watson, 1983:82). Sprague and Carlson identify some of these characteristics in six performance objectives stated from a user's perspective:

1. A DSS should provide support for decision making, but with emphasis on semi-structured and unstructured decisions.
2. A DSS should provide decision-making support for users at all levels, assisting in integration between levels whenever appropriate.
3. A DSS should support decisions that are independent as well as those that are interdependent.
4. A DSS should support all phases of the decision-making process.
5. A DSS should support a variety of decision-making processes but not be dependent on any one.
6. A DSS should be easy to use. (Sprague, 1982:26-27)

Decision Process. In order to design a system to support a decision process, it is useful to characterize the phases of decision making. Herbert Simon has characterized decision-making as a 3 step process:

> Intelligence: Searching the environment for conditions calling for decisions. Raw data are obtained, processed, and examined for clues that may identify problems.
>
> Design: Inventing, developing, and analyzing possible courses of action. This involves processes to understand the problem, to generate solutions, and to test solutions for feasibility.
>
> Choice: Selecting a particular course of action from those available. A choice is made and implemented. (Simon, 1960:2)

A decision support system should support a user in all three phases of the decision making process: exploring and defining the problem, examining alternative solutions, and selecting a particular course of action. Categorizing a decision makers' activities into these phases can be useful in determining required DSS operations (Sprague, 1982:98). It should be noted, however:

> The choice is not always straightforward; we might have multiple objectives; we usually operate under uncertainty; there might be conflicting interests; and the control of the implementation is not always feasible. The choice stage requires more heuristic processing such as 'what-if' programs. An additional requisite for this stage is the availability of control and feedback systems. (Ahituv, 1987:43)

Decision Structure. "By definition a fully structured problem is one in which all three phases- Intelligence, Design, and Choice- are all structured" (Keen, 1978:95). In such a problem, algorithms and/or decision rules would provide problem definition, alternative solution exploration, and solution selection. A structured decision does not require the utilization of a manager, but may be relegated to clerical

workers or solved via computer automation. Keen and Morton submit that DSS are most effective in solving semi-structured decisions. A semi-structured problem is one in which a manager's judgment must be merged with data, models, and/or clerical help to reach a solution. An un-structured problem is one that is either not capable of being structured or has not been examined sufficiently to provide structure. These problems are solved on the basis of the manager initiating and controlling the problem-solving sequence and process (Keen, 1978: 86,95).

Adaptive Design

One of the major benefits of DSS is the combining of models and analytic techniques with data base technology to provide the user with an interactive system that is flexible and adaptable to "accommodate changes in the environment and decision-making approach of the user" (Sprague, 1982:6). It is the *adaptable approach* that is a key element of DSS and sets it apart from the more traditional approach of completely defining system requirements prior to building a system.

One of the major problems facing system designers is that users cannot define system requirements. Traditional approaches have proven to be inadequate. Typically, system requirements are frozen and a system is built from a lengthy requirements specification document. Users needs are constantly changing and will not be the same by the time a system is designed, built, and implemented, often resulting in costly changes, or the system not being used in the manner for which it was intended (Valusek, 1988). Contrary to system analysis approaches which have well defined processes, "DSS need to be independent of any imposed process because different decision makers approach problem solving in

different ways" (Sprague, 1982:15). Sprague and Carlson state that "the typical systems development process (analysis, design, construction, implementation) are combined into a single step which is iteratively repeated" in order to provide "short, rapid feedback from the users to insure that development is proceeding correctly" and "to permit change quickly and easily" (Sprague, 1982:16). Sprague and Carlson suggest that this process starts with identifying an important sub-problem and developing a small usable system to assist the user, and continues in cycles as the system is evaluated, modified, and expanded (Sprague, 1982:140).

Identifying the initial kernel system is a key issue to be resolved. Suggestions for kernel selection range from choosing the most mundane, time-consuming, tedious task to the most nebulous, undefined, unstructured task (Valusek, 1988). A key point in this process is that the user is "the iterative designer of the system" and the systems analyst merely implements required changes and modifications (Sprague, 1982: 16). The major advantage of the adaptive design approach is that of flexibility: a small kernel system is selected and allowed to grow and evolve as requirements are defined and change.

One specific application of adaptive design is when "users do not know what they want and the designers do not understand what they need." The implementation of an initial kernel in this case gives the "users something concrete to react to" (Keen, 1980:15). The "users' concepts of the task or decision situation will be shaped by the DSS" and the user will shape the development of the DSS (Keen, 1980:15).

ROMC

From the users' point of view, a DSS must:

> provide representations to help conceptualize and communicate the problem or decision situation, operations to analyze and manipulate those representations, memory aids to assist the user in linking the representations and operations, and control mechanisms to handle and use the entire system. (Sprague, 1982:96)

Sprague and Carlson advocate defining decision support requirements from the user perspective using Representations, Operations, Memory aids, and Control Mechanisms known as the ROMC approach. This approach was developed from five observations from their analysis of decision makers:

1. Decision makers have trouble describing a decision-making process, but do seem to rely on conceptualizations, such as pictures or charts, when making or explaining a decision.
2. Simon's intelligence-design-choice scheme can be useful in categorizing decision-makers' activities, even though the decision-making process may be difficult to explain.
3. Decision makers need memory aids.
4. There are differences in decision makers' styles, skills, and knowledge.
5. Decision makers expect to exercise direct, personal control over their support. (Sprague, 1982:98-99)

ROMC is a tool to identify necessary capabilities for specific DSS in a process-independent approach. Representations include the full spectrum from scratch paper and memos to maps and graphs, and provide a user with the context in which outputs can be interpreted and operations may be invoked. Operations provide the opportunity to analyze and manipulate the representations and can be as simple as gathering and sorting data or as complicated as running a detailed analytical or simulation model. Memory aids provide for the retention of representations and

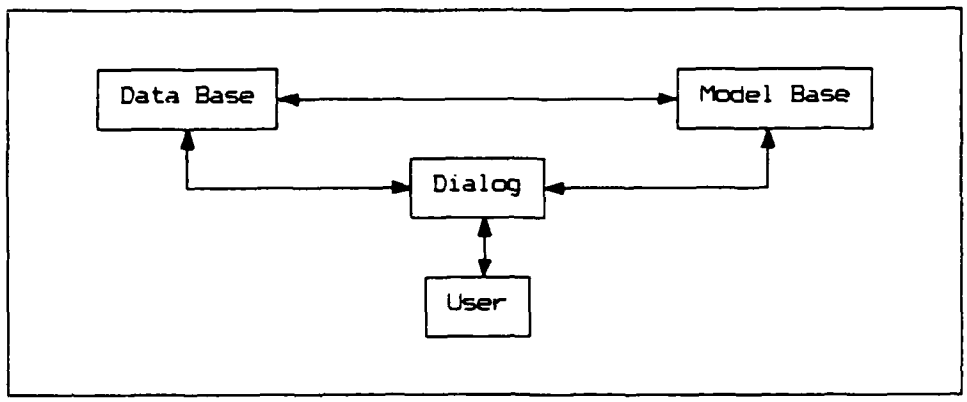


Figure 3.1 DSS Components

operations in the form of data bases, views, work spaces, triggers, etc. Control mechanisms help users synthesize the decision process based on individual knowledge, style, and skill. Control aids may take the form of menus, function keys, help commands, and the capability to combine operations or define new procedures (Sprague, 1982: 101-106).

DSS Components

As shown in Figure 3.1 a DSS is composed of three components: the dialog, the data base, and the model base.

Dialog. The dialog component is the hardware and software that provides the interface between the user and the DSS. In terms of ROMC the dialog:

1. Produces the output representations.
2. Enables user inputs that invoke and provide parameters for the operations
3. Enables user inputs that invoke and provide parameters for the memory aids
4. Provides the control mechanisms that enable the user to combine outputs and inputs into processes (dialogs) (Sprague, 1982:198)

Data Base. The data base supports the memory requirements of a DSS. In terms of Simon's model, it supports the intelligence portion of the decision process. Different DSS will have different requirements, but the following are some of the more common:

1. Support for memory aids such as work spaces, libraries, links, and triggers
2. Support data reduction capability
3. Support various levels of data detail
4. Support multiple sources of data
5. Support a catalog of data sources
6. Support data security
7. Interface with other DSS components
8. Interface with the user at the external level (Sprague, 1982:240-242)

Model Base. The model base provides the analytic capability to fully analyze the problem and compare alternative solutions. The model base may consist of permanent, ad hoc, user-built, and/or "canned" models. There may be a variety of models within a single DSS with some of the smaller ones acting as building blocks to support the construction of larger models. (Sprague, 1982:257,262). The model component supports Simon's design and choice activities.

Proposed Approach

The main emphasis of adaptive design is to form an anchor point, evaluate, and adjust. The initial step consists of eliciting requirements from the user. "Requirements can be thought of as the representation of a need that may be initiated by any individual or group at any organizational level" (Valusek, 1987:140). Concept maps are used to

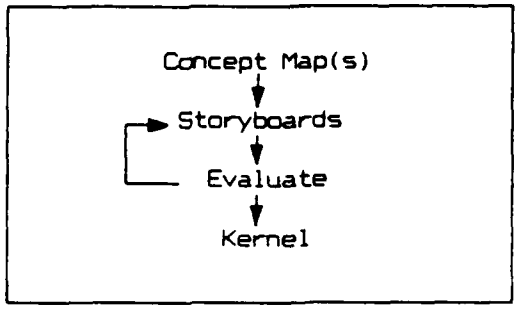


Figure 3.2 Selection of a Kernel
(Valusek, 1988)

bound the problem and help identify the initial anchor point. A series of storyboards are constructed to provide a visual representation of user requirements. The quality of these representations set an upper bound on the quality of the resulting system (Valusek, 1987: 141). These storyboards serve as a means to reduce communication obstacles between the user and builder. The process of evaluating these storyboards and adjusting them to reflect the user's requirements eventually results in defining the kernel system to be built (Valusek, 1988). This process is shown in Figure 3.2.

A feature chart displays the interfaces and controls available to the user (Seagle and Belardo, 1986:11). Ideas that are not part of the kernel, but are important for later evolution of the DSS are documented in a "hookbook" (Valusek, 1988). Evaluation criteria are also necessary at the development stages of the DSS. A discussion of each of these topics follows.

Concept Map. "A concept map is an informally obtained representation of objects, events and their inter-relationships" (Valusek,1988). A concept map may represent several samples from the same user over time

or may be a collection of multiple user samples. A concept map provides a tool for "problem definition and kernel identification during the design phase of a DSS" (McFarren, 1987:194). Some of the advantages of using concept mapping include: 1) transferring understanding between individuals; 2) identifying inconsistencies and misconceptions in an individual's understanding of the problem; 3) the ability to capture an individual's understanding of a specific problem space; 4) the ability to capture an individual's decision process elements; and 5) providing a forum for discussion and evaluation to the DSS design team (McFarren, 1987:195-196).

Storyboard. "A storyboard is a sequence of displays that represents the functions that the system may perform when formally implemented" (Andriole, 1988:80). Storyboarding communicates system functions to the intended users at a small cost, protecting against "false starts, inaccurate requirements definitions, and over-eager programmers" and allows the entire development process to be iterative (Andriole, 1988: 80-81). Storyboards may be paper or actual screen displays. ROMC provides an effective "checklist" approach for developing storyboards. Each storyboard should communicate the user's requirements in the form of representations, operations, memory aids, and control mechanisms. Once the user agrees on the storyboards, system construction can commence.

Feature Chart. A feature chart "is a synthesis of the ROMC model and structured analysis" and is a "graphics tool for analysis and communications" (Seagle and Belardo, 1986:11). A feature chart uses standard flow chart symbols to show interfaces, paths, and flexibility of a

DATE:	SUBJECT:
IDEA:	
CIRCUMSTANCE:	

Figure 3.3 Hookbook Card

proposed system from the user's perspective (Seagle and Belardo, 1986: 19). Feature charts are particularly useful in providing a "you are here" perspective and giving a pictorial layout of how the storyboards are linked together.

Hookbook. A hookbook is a "memory aid mechanism for requirements" which is actually a perception of the user's needs. These statements of need may be written on note cards or may be part of an automated note file within the DSS. As shown in Figure 3.3, there are four important pieces of information that need to be captured in a hookbook entry: the date, subject matter, idea, and circumstances surrounding the idea. Recording of the particular circumstances that caused the entry provides an individual with a memory aid of why he/she thought the idea was important at that particular point in time (Valusek, 1988).

Evaluation. DSS evaluation is one of the most important parts of the adaptive design process. "Evaluation is a systematic process of judging how well objectives have been met" (Valusek, 1988). Evaluation should begin before the technical phases and continue beyond the life of

the DSS. Beginning evaluation before system construction will aid in determining what DSS to build and help assess the impact of the DSS on decision-making. Sprague and Carlson suggest four types of measures for evaluation:

1. Productivity: Measures the impact of the DSS on decisions. Examples include time to reach a decision, cost of making a decision, results of a decision, and cost of implementing the decision.

2. Process: Measures are used to evaluate the impact of the DSS on decision making. Examples include number of alternatives examined, number of analyses done, time spent in each phase of decision making, and amount of data used.

3. Perception: Measures are used to evaluate the impact of the DSS on the decision makers. Examples include control of the decision-making process, usefulness of the DSS, ease of use, ease of "selling" the decision, understanding of the problem, and conviction that the decision is correct.

4. Product: Measures are used to evaluate the technical merit of the DSS. Examples include response time, availability, development costs, O&M costs, education costs, and data acquisition costs. (Sprague, 1982:158-160)

Application of DSS and Adaptive Design to the ESC Problem

DSS and adaptive design seemed to be the most promising approach to the ESC officer resource management problem. A DSS would provide resource managers with an interactive system that combines data retrieval and models to support the semi-structured decisions involved in officer assignments and career management. Officer qualifications and job requirements information could easily be appended to existing data bases. A rule-based model would be very useful in providing officer career planning. A goal programming, multi-criteria, or linear programming assignments model would be useful for providing recommendations of

how to assign officers to jobs.

Adaptive design allows the user to specify the requirements, help design the DSS, and evaluate its performance. This approach allows flexibility in the design of a DSS. Quite often final requirements cannot be stated by users in a firm way that allows a complete system to be defined and built. This was certainly true of ESC. At the start of this thesis effort, ESC did not have answers to the subsidiary questions stated in Chapter I, all of which are important to a particular system design.

Application of the adaptive design approach to ESC's officer resource management problem is discussed in Chapter IV.

IV. Application of the Adaptive Design Approach

As discussed in Chapter III, the adaptive design process involves the identification of a small kernel system which is allowed to grow and evolve as requirements are defined or change. Requirements are elicited from the user through the use of concept maps, which help to bound the problem and identify an initial anchor point for kernel development. Storyboards are constructed to provide a visual representation of the user's requirements. The evaluation and changing of these storyboards by the user provides the foundation for defining the kernel.

Concept Map

The concept map in Appendix B is the result of several phone conversations and meetings with ESC/DPQ and ESC/DPR personnel. The concept map is divided into two parts, each on a separate page. The first part, Figure B.1, displays the interaction between an ESC officer resource manager and key individuals in the officer assignments process. These interactions are shown in a simplified format in Figure 4.1. The second part, Figure B.2, represents the ESC officer resource manager decision making environment. Each part of the concept map will be discussed in some detail.

ESC Resource Manager/Officer Interaction. One of ESC's major concerns is the loss of experienced personnel to other MAJCOMs. One possible solution, listed in Appendix A, is to create an atmosphere that is conducive to officers wanting to stay in or return to ESC. An important aspect of this atmosphere is the perception that resource managers are making assignment decisions based on each officer's best interest.

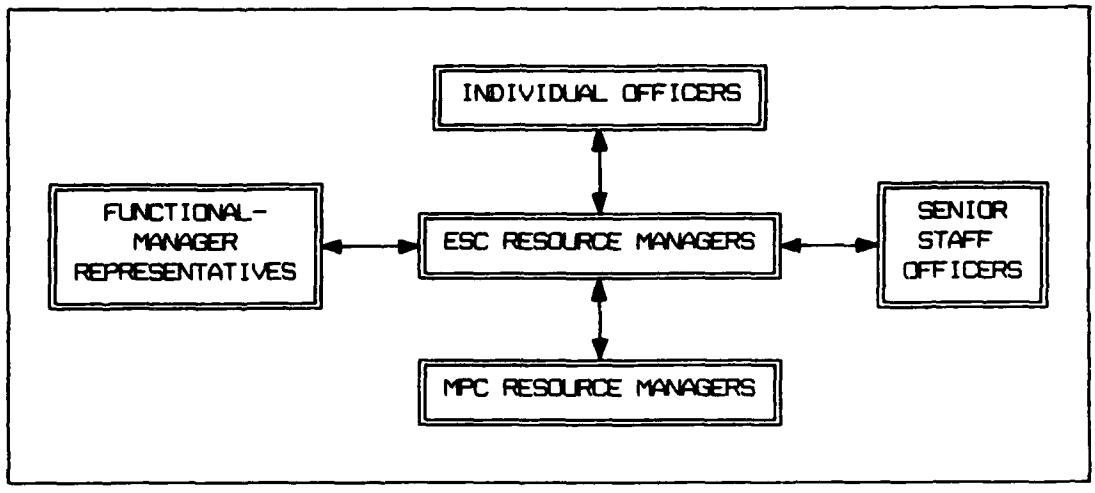


Figure 4.1 ESC Resource Manager Key Interactions

This perception is tremendously influenced by the amount of information available to each resource manager: familiarity with each officer's accomplishments and needs, knowledge of available jobs, and ability to offer sound career counseling advice.

ESC/DPRO personnel identified the need to automate personnel and manpower data base information on a desk top PC or terminal in order to provide quick access to information during the course of the multitude of phone calls they receive from officers every day. An automated note file was also identified as a necessary memory aid that would preclude the numerous scraps of hand-written notes that must be later sorted and filed. Although this limited information would provide immediate access to information currently in the personnel and manpower data bases, it would not meet the biggest need of a calling officer - specific information about an available assignment. This information deficiency could be remedied by adding fields to the current manpower data base which

would include a short job description and the name and number of a point of contact for further information.

ESC/DPQ personnel identified the need to quantify each ESC officer's qualifications and each ESC job requirement in such a manner as to allow for a better matching of officers to job requirements. This information would also be useful in developing a suggested career progression for each officer AFSC. Once this suggested career progression was established, it could be automated in a usable form for the resource managers to use in the course of a phone conversation.

ESC Resource Manager Interaction with ESC/HQ Personnel. Within ESC Headquarters, ESC resource managers rely on functional-manager representatives and senior staff officers to make recommendations for key officer assignments. Being a small command, most ESC officers are known by at least one staff officer at HQ ESC. As such, candidates for key positions are carefully screened by functional managers and senior staff officers. ESC resource managers are merely a filter between MPC and HQ ESC for these types of assignments. Even in the case of not-so-key assignments, senior staff officers may have strong opinions of which officers should be assigned to which jobs. Incorporating support for these interactions in the DSS is beyond the scope of this thesis.

ESC/MPC Resource Manager Interaction. One major obstacle, if not the key obstacle to placing the best qualified officers in the desired ESC billets, is the fact that ESC resource managers merely provide assignment recommendations to MPC and do not hold final decision authority. An important evaluation criteria of the DSS will be the "sellability" of each assignment recommendation. Although the evaluation of

DSS success can be measured in a before and after comparison of assignment recommendations accepted by MPC, a more difficult question is "How does one design the DSS to produce a more sell-able product?" ESC/DPQ personnel feel that defining job requirements and personnel qualifications on a greater detail than is currently available in the PDS and Manpower data bases is the first step to providing better assignment recommendations. The rapport between resource managers is also an important factor in assignment sell-ability. Other than providing ESC resource managers with information that may be useful in building this rapport, no plans were made to incorporate a specific "rapport capability" in the DSS.

ESC Resource Manager Decision-Making. ESC resource managers had difficulty describing the process of how an officer assignment is made. DPQ and DPR personnel and functional-manager representatives all indicated that intuition/gut-level feeling/subjectivity plays a large role in this process. This approach to officer assignments is largely due to the complexity of criteria, much of which has not been well quantified. It was necessary to quantify some of the more important criteria in order to facilitate DSS component development. Since ESC personnel also found it difficult to offer suggestions of how to quantify assignment and career management criteria, a prescriptive approach to criteria selection and quantification is offered in Chapter V.

Answering the Subsidiary Questions

Not all of the requirements necessary for kernel selection were elicited by concept mapping. Several questions were posed to ESC in the form of the subsidiary questions from Chapter I. Unfortunately, ESC was

not able to supply very detailed answers to many of these.

At the very heart of the ESC Force Development Program lies the problem of defining job requirements, classifying personnel, and establishing a method to match the two. Several discussions were held with DPQ personnel, none of which produced a recommended approach to the problem. The following approach was submitted to DPQ as one method for attacking the problem.

The documentation of job requirements will mandate the elicitation of inputs from supervisor's of officers throughout ESC. A survey that could be used to collect this information is provided in Appendix E. Within the survey, job requirements are collected in terms of 3 basic criteria. First, every job has some minimum level of qualifications that an officer must meet before being considered as a possible candidate for the job. Second, in addition to the bare-minimum essentials, there are certain additional skills and qualifications that would be very useful in performing the job. Finally, there are new skills and qualifications that an officer can be expected to acquire over the course of a 3-4 year tour in the job assignment. A means of quantifying each of these criteria for use in an assignments model is developed in Chapter V.

After documenting job requirements for all of ESC's officer billets, a master list of all important officer skills and qualifications can be compiled. Using this list as a guide, individuals can be tasked to perform officer record reviews and build data base fields that reflect each officer's expertise relative to ESC job requirements.

A method for comparing officer qualifications and career development needs to job requirements and selecting the "best assignment" for each officer is presented in Chapter V. Since real data did not exist at the time of this thesis, arbitrary alpha-numeric coding is used to simulate actual job requirement and officer skills data.

At the time of this thesis ESC did not have an ESC officer career development plan, nor did there seem to be any plans to develop one. Before ESC can answer the question "Are we building the necessary pool of qualified individuals for tomorrow's needs?", those needs must be quantified in such a manner that allows the monitoring of individual career progression against a career plan. In an organization such as ESC, the plan may outline an officer's suggested career progression toward one or more of the many O-6 billets in the organization. Those career guidelines can be communicated to the officers in the organization, used by the resource managers to make assignment decisions, and used as a measuring device to answer the aforementioned question. The DSS storyboards presented in Appendix C and discussed later in this chapter illustrate how career guidelines can be used in such a manner.

In an attempt to define the computer resources necessary to build a DSS for the officer resource managers, it was initially decided that each resource manager should have their own PC and the personnel data base files on each PC would contain only the personnel files of the officers for which each resource manager is responsible. This suggestion lead to such questions as: "What inconvenience will this create when a resource manager answers the phone for another resource manager who is not in the office or is covering for a resource manager who is on leave?"

and "Is there a way for the branch chief to access all ESC data base information from a terminal on his desk?" There were also additional concerns that perhaps functional-manager representatives should also be given access to the finished system. While DPR personnel desired the capability of centralized data base files that could be accessed from any terminal in the office, DPQ personnel seemed reluctant to commit to acquiring the resources for such a capability before a proof of concept was demonstrated. It was decided that a proof of concept should be demonstrated on a single PC using off-the-shelf software before committing resources to a local area network, a micro VAX, or main frame system.

Initial Anchor Point

Because of ESC's inability to define many of the requirements in a manner that would facilitate system development, identification of an initial anchor point was very difficult. DPR resource managers were interested in developing an automated data retrieval system to aid in their job responsibilities, and DPQ personnel were interested in implementing a system that would address the ESC/CC directed force development effort. New solutions were readily embraced almost as fast as they were suggested. The remainder of this thesis was dedicated to helping ESC focus on how to develop a DSS that would aid in the Resource Manager/Officer interaction problem as well as making better officer assignment recommendations. The remainder of Chapter IV discusses feature charts, storyboards, and evaluation criteria for this DSS. Chapter V addresses the development of a computer model to match officer experience to job requirements.

Feature Chart/Storyboards

Appendix C contains a series of storyboards which are the result of several iterations with ESC/DPQ and DPR personnel. Two feature charts are provided to show screen connectivity and where models are used to support the screen displays. Since each storyboard was designed using Sprague and Carlson's ROMC approach as a checklist, the help screens display information under the headings Representations, Operations, Memory Aids, and Control Mechanisms. An additional section, Requirements, describes the particular ESC need addressed by each storyboard.

The main menu provides a user with six options, only two of which are addressed in this thesis: Answer Phone/Provide Career Counseling and Work Officer Assignments. The Officer Data Base, Jobs Data Base, and Planner-Tracker Automated System are all currently being built by ESC/DPQ. The Automated Force Planning System is a simulation model that ESC/DPQ is planning to build in 1989.

Answer Phone/Provide Career Counseling. The "Answer Phone" option provides a resource manager with a tool to more effectively deal with the most hectic part of his/her job - answering the many phone calls from officers looking for assignment information. A calling officer's name is entered from the keyboard, and the resource manager is provided with background information on the individual (C-5). An automated note file on the officer is available through a window which enables the resource manager to record important facts during the course of the conversation as well as review any notes taken from any previous conversations, discussions, or record reviews. At this point, the resource man-

ager has the option of performing a quick review of the calling officer's personnel record for any glaring problems or special assignment considerations (C-7), performing a more in-depth record review (C-9), providing the caller with a list of projected available assignments (C-11), or providing the officer with career counseling advice (C-13 through C-18).

As discussed in Chapter I, resource managers are major players in officer career counseling. A tool to measure an officer's career progress against some standard and provide recommendations based on this evaluation would greatly enhance a resource manager's capability to perform career counseling. Currently, with the exception of AFR 36-23, a standard does not exist. AFR 36-23 does not provide the specific level of detail for a MAJCOM to directly implement a career path for each of its officer AFSCs. It is recommended that ESC develop a more specific career plan for each of the major officer AFSCs in ESC. This career guidance could be built into a rule-based model that evaluates an officer's career and makes recommendations for training, education, PME, and assignments as portrayed on pages C-13 through C-18.

Presently, resource managers do not have detailed information on the jobs to which they assign officers and officers do not have access to adequate information detailing what jobs are available and what those jobs entail. This problem could be partly remedied by providing resource managers with more information. Page C-11 shows a capability that could easily be developed by having all unit commanders submit a 2 to 3 sentence job description on each job in their unit, a point of contact for more information, and a list of experience requirements neces-

sary to qualify for the job. As discussed earlier in this chapter, this capability would provide resource managers with the ability to field a calling officers questions about what jobs are available, what those jobs entail, and who to call for more information. Additionally, making such information available to individual units in the form of hard copy or floppy disks may greatly reduce the amount of phone calls inundating the resource managers. This information would also allow officers to choose from the projected job vacancies and indicate their desires in the Immediate Assignment Objectives block of the Form 90.

Work Officer Assignments. The "Work Officer Assignments" option provides a resource manager with the capability of working an individual assignment or a group of officer assignments corporately. The single officer assignment option is illustrated on pages C-22 through C-25. As discussed previously, determining which jobs are best for an officer's career could be the output of a rule-based model. Choosing a job based on an officer's experience is based on the model developed in Chapter V. The capability to pick assignments that enhance future ESC force development will depend on the output of the Automated Force Planning Model.

Pages C-26 through C-35 illustrate the capability of building a list of officers eligible for reassignment and a list of jobs projected to be vacant during the officers' PCS window, scoring each of the officers according to how well they meet the requirements for each job, and running an assignments model that selects the most qualified officers for each job. Resource managers must be able to convince MPC that these individuals are the best choices for each job. The detailed documenta-

tion of mandatory and desired qualifications for each job, along with the officer scores provide a basis for defending these recommendations.

Hookbook

Many ideas for potential DSS capabilities surfaced during discussions with ESC and MPC personnel. Some of these were incorporated in the storyboards in Appendix C. Others, while good ideas, would not be practical to build in an initial kernel system. Those ideas that were not incorporated in the proposed DSS are recorded in Appendix D for future consideration. Some of the capabilities shown in Appendix C did not exist at the time of this thesis. These capabilities are also included in the hookbook. Hookbook entries are sorted chronologically within four subject classes: 1) career plan; 2) data bases; 3) models; and 4) dialog.

Evaluation

At the time of this thesis, ESC/DPQ had not put a lot of thought into evaluation criteria for the DSS. Table 4.1 presents some potential measures for evaluation in terms of Sprague and Carlson's four categories of evaluation measures.

DSS success needs to be considered from the three perspectives presented in Chapter I. From the ESC/CC perspective, success will be defined as having an ample supply of well qualified officers to fill ESC billets. From the perspective of an officer preparing to PCS, success will take on a multitude of definitions; however, success for the career-minded officer most likely means obtaining an assignment that is challenging, maximizes the probability of promotion, provides career

TABLE 4.1

Potential DSS Evaluation Criteria

1. Productivity measures:
   a. Time to reach an assignment recommendation
   b. Resource manager time spent on the phone
   c. Resource manager idle time
   d. Number of assignment recommendations per unit time
   e. Percentage of recommendations accepted by MPC
   f. PCS budget required
   g. Number of highly qualified ESC officers in the pool
   h. Quality of ESC officers in the pool
   i. Officer job satisfaction
   j. Officer job productivity
   k. Officer promotion rates

2. Process measures:
   a. Number of assignments considered for each officer
   b. Number of officers considered for each assignment
   c. Amount of data used in making a recommendation
   d. Time between assignment and actual PCS date

3. Perception measures:
   a. Usefulness of decision aid
   b. Confidence in recommendations
   c. Resource manager knowledge of officer skills and job requirements
   d. Officer confidence in resource managers and their recommendations
   e. Resource manager ability to sell recommendations to MPC
   f. Level of resource manager job stress

4. Product measures:
   a. RDT&E costs
   b. O&M costs
   c. Accuracy of data base information
   d. Ability to access all necessary information within the decision aid

enhancement, and provides maximum job satisfaction. Success from the perspective of the resource manager may mean many things as well, but ultimately it means satisfying ESC/CC, MPC, and the officers being assigned.

Kernel Identification

Appendix C is proposed as an initial anchor point that ESC must evaluate and adjust in order to define the kernel system to be built. ESC/DPQ currently has automation personnel building the Tracker-Planner Automated System using dBase III Plus. These personnel could easily add fields to the officer and jobs data bases to support the storyboard designs in Appendix C. Additionally, these personnel have already written the computer interface needed to do a monthly down-load from the PDS system to floppy disc. This interface would need to be slightly modified to accommodate these new fields.

The Answer Phone portion of the storyboards can be built relatively easily using dBase III Plus. The screen displays and menu driven data base query capability can all be designed using the dBase III Plus programming language. The notepad capability is available in dBase III Plus through the Memo field. The career counseling and rule-based model portion of this option cannot be built until an ESC officer career plan is defined.

Since ESC/DPQ is currently attempting to define specific job requirements and document personnel qualifications in terms of those requirements, a limited Work Officer Assignments option can be built. ESC/DPR personnel identified the primary need for a capability of working multiple assignments. Lists of officers eligible for assignment and projected job openings can be built with a data base sort routine. A model that matches officer qualifications to job requirements is presented in Chapter V.

V. A Prescriptive Approach to Officer Assignments

Success of the ESC Force Development Program will depend on the ability of ESC/DPQ to accurately define job requirements, classify officers, and develop a method of assigning officers to jobs that not only selects the "best qualified" person for each job, but also considers the impact of an assignment on developing each officer's skills for future assignments in ESC.

Criteria Development

The officer assignment decision-making environment is filled with complex criteria, many of which have not been well quantified. When ESC personnel were unable to furnish suggestions of how to quantify officer assignment and career management criteria in a manner that would facilitate model development, it became necessary to provide them with a prescriptive approach that they could react to. Figure 5.1 was presented to ESC/DPQ and DPR personnel for just that purpose. Figure 5.1 is a Venn diagram of some of the more important criteria that could be considered in making an assignment for an imaginary Capt John Doe, who is currently a 8035. Each criterion identifies a subset of jobs that would be beneficial to Capt John Doe and/or ESC. Obviously, the "best" job is one that satisfies all the criteria. When such a choice is not possible, the decision maker must decide which criteria are the most important. Four types of assignments have been omitted from the diagram for simplification: 1) career broadening assignments; 2) assignments that may require an advanced academic degree (AAD); 3) assignments other than

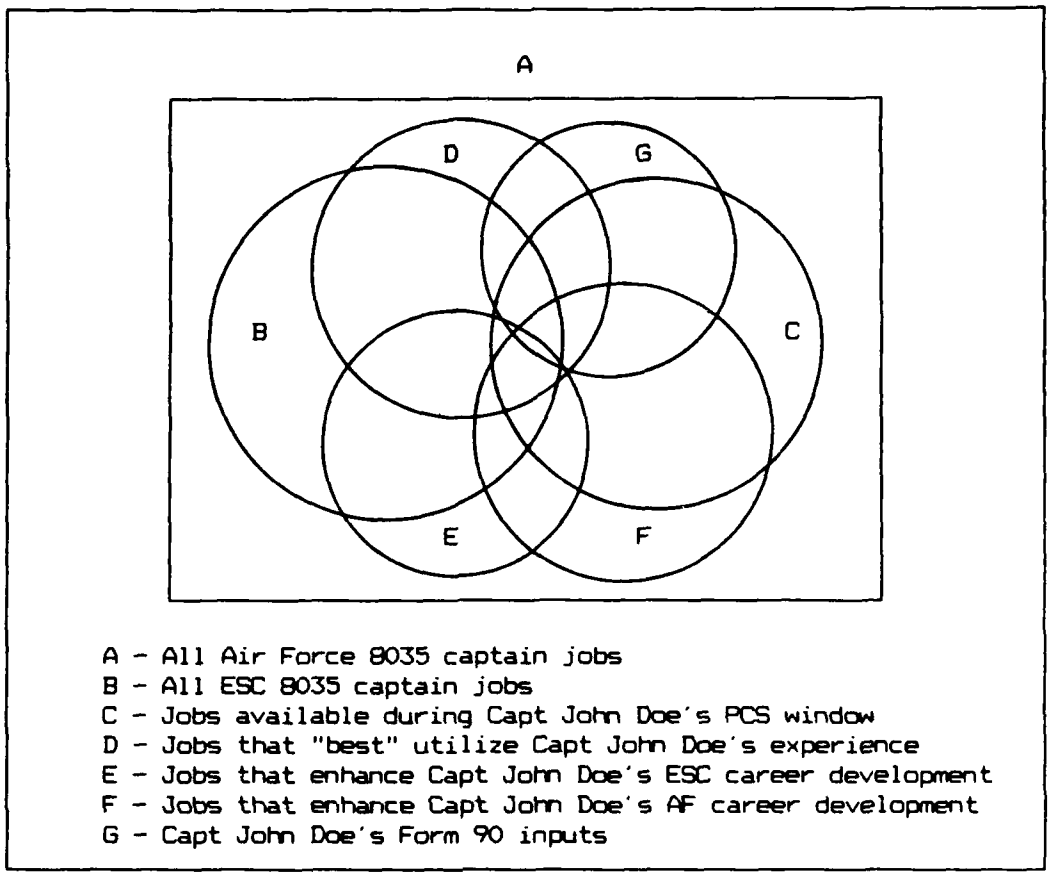


Figure 5.1 Assignment Criteria for Capt John Doe

those listed as captain's billets; and 4) assignments that result in the retraining of an individual to a new AFSC. ESC's reaction to Figure 5.1 formed the basis for which criteria should be included in a DSS model, and which criteria should be entered in the hookbook for later consideration.

Simplifying Assumptions. Discussions with ESC personnel yielded the following simplifying assumptions for the DSS model:

1. The model will only consider officers for jobs requiring their primary AFSC. Any individuals desiring to retrain to another AFSC or desiring an assignment in their secondary AFSC will be handled on an individual case by case basis by the resource managers.

2. AAD jobs and career broadening assignments are relatively few, and will be worked on an individual case by case basis.

3. Whenever possible, individuals on promotion lists will be assigned to jobs requiring their promotion rank.

4. Officially, officers are only assigned to vacant jobs. In reality, officer job position numbers, titles, and AFSCs are frequently juggled to accommodate the assigning of an officer to an otherwise "impossible" job match. A capability that considers such rearrangements could potentially improve the match of officer skills and career needs to job requirements, but since DPR was not able to supply rules or conditions to facilitate such a capability, it will not be considered in the model.

5. A resource manager should consider the effect of each assignment on an officer's overall Air Force career. Unfortunately, this involves the application of the unwritten rules alluded to in Chapter I. Since DPR was unable to quantify these unwritten rules in a manner that they could be incorporated into the DSS, they will not be included in the model.

6. Since ESC does not have a career development plan for ESC officers, no capability could be developed that compared each assignment's direct impact on an officer's ESC career development. The model does seek to place officers in jobs that develop additional skills. These skills do impact ESC career development, but there is no way to measure the extent to which they do so.

7. An officer's AF Form 90 can be an important piece of information for the resource manager to consider. A major problem in trying to incorporate an officer's Form 90 inputs into the assignment criteria is that the Form 90 does not represent an officer's response to the actual jobs for which he/she is being considered. It would be useful to have officers rank order the assignments for which they are being considered, and use these inputs along with the other model criteria, but since ESC/CC's stated policy is that the needs of ESC come first, an officer's personal desires will only be used to break a tie between two or more jobs for which he/she is equally qualified.

8. DPR indicated that no more than 15 officers are considered for an assignment at any one time and all officers compete for jobs on an equal basis.

9. When the number of available jobs exceeds the number of officers being considered for reassignment, there must be some way of determining which jobs will be filled. While DPR stated that all jobs are filled under the same priority level, they also were favorable to subjectively deciding which jobs should

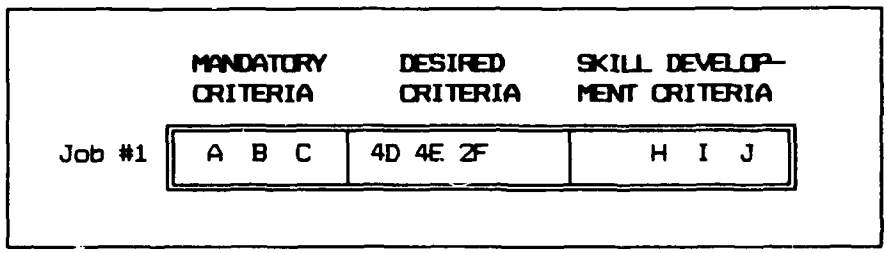


Figure 5.2 Job Requirements

be filled (since that is the way business is currently conducted). Thus, it is assumed that the resource managers will build a list of jobs to be filled equal to the number of officers available for reassignment.

10. Since real data did not exist at the time of this thesis, alphanumeric codes are used to simulate job requirements and officer skills data. DPQ plans to use a similar coding system for the officer and job data bases.

Weighting Job Requirement Factors

The Work Officer Assignments portion of the storyboards in Appendix C (C-26 through C-35) assumes that all jobs are described in terms of mandatory, desired, and skill development criteria which were briefly mentioned in Chapter IV. Each of these criteria is composed of several factors which are represented as alphanumeric characters. The example from C-32 is reproduced in Figure 5.2 for easier reference.

As discussed in Chapter IV, every job has some minimum level of experience that an officer must possess before being considered for that position. Currently, the Air Force assigns all officers based on minimum criteria, primarily rank and AFSC. It is ervisioned that ESC will be able to add additional minimum level qualifications to many jobs so that these requirements become a useful discriminator between officers with the same AFSC and rank. These minimum level factors com-

prise the mandatory criteria portion of Figure 5.2. Although mandatory criteria factors may not be equally important, an officer is not qualified to be assigned to a job without meeting all the mandatory criteria factors. Thus, it will not be necessary to weight the mandatory criteria factors. If only a handful of officers in ESC meet all the mandatory criteria factors for a particular job, the responsible supervisor may want to consider changing some of the mandatory criteria factors to desired criteria factors.

In addition to the minimum experience requirements for each job, there are certain skills and experiences that would be highly useful in enhancing an officer's job performance. Assigning officers to jobs where they meet the desired qualifications is a step toward placing the "best qualified" officers in each job. An officer not possessing these additional experiences may need on-the-job or formal training to develop those skills. Since the desired criteria will be used to select "the best person" for each job, it is important to be able to distinguish which factors are the most important. As shown in the survey in Appendix E, the supervisor will rank order these factors. The supervisor will also weight the importance of each factor by performing a pair-wise comparison between the least important factor and each of the other factors.

Since the actual number of desired criteria factors and resulting weights will vary from job to job, it will be necessary for ESC to normalize the factor weights for use in the assignments model. The objective of the normalization procedure is to insure that the sum of all desired criteria weights for each job is the same so that the assign-

ments model will seek to fill all jobs on an equal priority basis. For example, assume that a supervisor submitted desired criteria 2D, 2E, and 1F and it is desired to normalize the sum of the desired criteria weights to 10. Taking 10 and dividing it by the sum of the supervisor's weights, one obtains 2. All the original factor weights are then multiplied by 2, and the result is displayed in Figure 5.2.

As an officer spends 3-4 years in a job, he/she will develop additional expertise that will hopefully be useful for future assignments in ESC and/or the Air Force. Managing the development of these skills is a goal of the ESC Force Development Program. The importance of the skill development criteria factors actually should depend on two things: 1) the career needs of each officer; and 2) the future needs of ESC. The Automated Force Planning System Simulation Model will be the primary tool for determining the future skill needs of ESC by officer AFSC and year group. Since this model has not yet been built, determination of factor importance will come from a resource manager's evaluation of each officer's career needs. This capability could be built into a rule-based model such as was described in Chapter IV. Since such a capability does not exist, nor does there exist any firm career development guidance, the resource manager will have to subjectively determine each officer's career needs.

The actual weighting of an officer's skill development needs would be done in much the same manner as was described for the desired criteria factors with the exception that the resource manager will perform both the weighting and normalization. These factors will be stored as fields in each officer's record and compared against the skill development criteria factors of each job. In the following example, the offi-

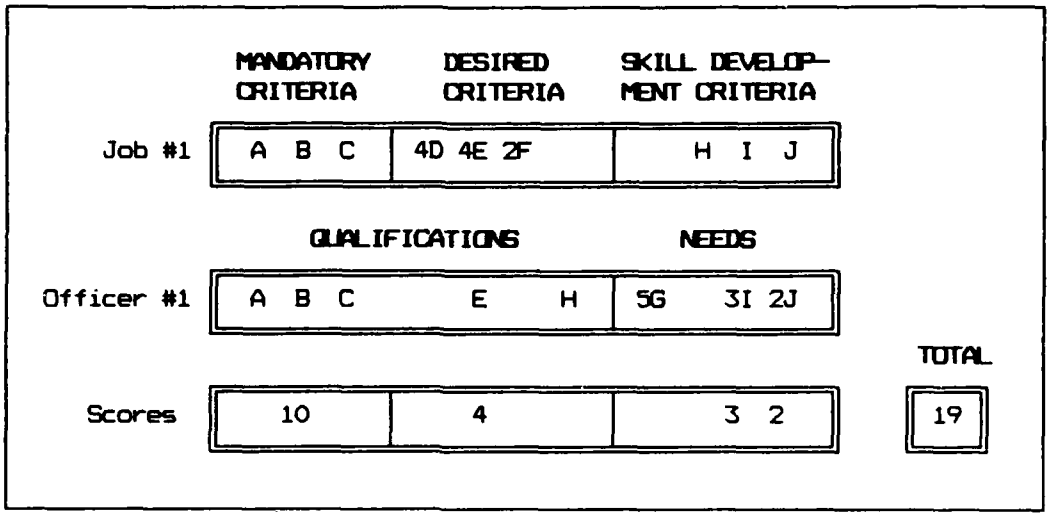


Figure 5.3 Scoring an Officer

cer's skill development needs were also normalized to 10.

Scoring Officers for Jobs

Since the officer and job data bases will be maintained in *dBase* III Plus, the scoring of officers for jobs will also be done in dBase III Plus. This provides the resource manager with the flexibility of sequencing through jobs and/or officers in any manner desired. The resource manager also has the option of windowing in detailed information on each officer's record, a description of each job, and the definition of any codes being used. The storyboard example from C-32 is reproduced in Figure 5.3 for easier reference.

If an officer meets the mandatory criteria for a job, a 10 will be entered in the first score block. In the event that an officer does not meet the mandatory criteria, a 0 will be entered in the total score block since he/she is not qualified for that particular job. For each of the desired criteria factors, an officer will receive the factor

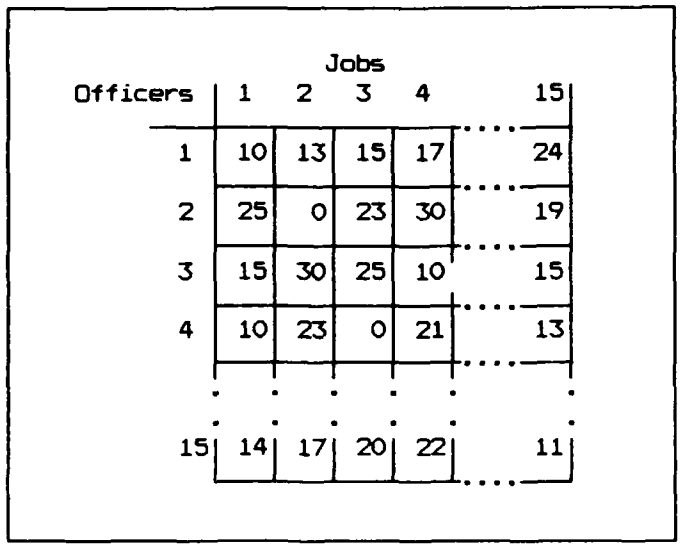


Figure 5.4 Matrix of Scores

weight value for each skill or experience that he/she possesses up to a maximum score of 10. Finally, the officer will receive the factor weights for those needed skills that are provided by that particular job.

As an officer is scored for each job, the total scores will automatically be stored in a separate file, where each officer's scores are fields of a record. When all officers have been scored, the complete file will resemble Figure 5.4. Since ESC/DPR indicated that no more than 15 officers from any one AFSC would be considered for assignments at any one time, the record and field sizes have been limited to 15. In the case that less than 15 officers are being considered for jobs, the additional fields and records will be filled with zeros.

Officer Assignments Model

The officer assignments model was formulated as an integer linear

programming assignment problem. This approach was selected rather than a goal programming or weighted-sums approach due to ESC's inability to identify criteria preference and/or assignment goals. By normalizing the sum of all criteria factor weights to 10, each criteria is treated as equally important. Both goal-programming and point estimate weighted-sums models are presented in Appendix F should ESC decide to specify assignment goals and/or different criteria weights.

The assignment problem formulation approach insures that one officer is selected for each job and one job for each officer based on maximizing the total sum of officer scores for jobs. Higher scores represent officers that are better qualified for jobs and/or officers that will be developing new skills for future ESC assignments. Although this method does not insure the "best qualified" officer is selected for each job nor that each officer is placed in a job that maximizes his/her skill development, it does attempt to trade-off these two criteria across a pool of officers being considered for assignment:

Decision Variables:

$$X_{ij} = \begin{cases} 1 & \text{if officer } i \text{ is assigned to job } j \\ 0 & \text{otherwise} \end{cases}$$

Parameters:

C_{ij} = The score of assigning officer i to job j

Objective Function and Constraints:

$$\text{MAXIMIZE:} \quad Z = \sum_{i=1}^{15} \sum_{j=1}^{15} C_{ij} X_{ij}$$

(Total sum of scores when officer i is assigned to job j)

$$\text{SUBJECT TO:} \quad \sum_{j=1}^{15} X_{ij} = 1 \quad \text{for } i = 1 \text{ to } 15 \quad \text{(Assign every officer to a job)}$$

$$\sum_{i=1}^{15} X_{ij} = 1 \quad \text{for } j = 1 \text{ to } 15 \quad \text{(Fill all jobs)}$$

$$X_{ij} = (0,1) \text{ for all } i,j \quad \text{(Solutions must be integer)}$$

Software. While no off-the-shelf linear programming software package will directly interface with dBase III Plus, several will read from and write to a spreadsheet. The matrix of officer scores for jobs could be written from a dBase III Plus file directly to a spreadsheet, where the records (officers) would appear as rows and the fields (job scores) would appear as columns. A linear programming package could read the scores from the spreadsheet and solve for the best officer/job match. The solution could then be written to a spreadsheet, where dBase III Plus could read and display the solution in a format similar to that shown on C-34.

Summary

The adaptive design approach was applied to the ESC officer force development problem in Chapter IV. A prescriptive approach to officer assignments was presented in Chapter V. These two chapters lay a foundation for the ESC Officer Assignment and Career Planning Decision Support System. Chapter VI summarizes this thesis and presents a building plan for the DSS.

VI. Summary and Recommendations

The main objective of this thesis was to design a decision aid to help the ESC officer resource managers choose the "best qualified" officers for each assignment while also considering the career needs of each officer and the future force requirements of ESC.

An initial site interview with the ESC officer resource managers revealed a decision-making environment that was inundated with phone calls while lacking:

1. Automation.
2. Sufficient information to ascertain the "best qualified officer" for an assignment.
3. An ESC career plan from which to evaluate an officer's career development needs.
4. Information regarding ESC's future force development needs.

It was apparent that ESC resource managers needed a computerized data system for quick access to officer and job data to answer the seemingly overwhelming number of daily phone calls as well as models that could compare officer qualifications against specific job requirements, officer career progression against an ESC officer career plan, and future force requirements against the present ESC officer force structure.

Further interviews with ESC resource managers revealed that subjectivity and intuition play a large role in officer assignments. This is largely due to the fact that complex criteria contained in several instructions and regulations as well as numerous unwritten rules have not been quantified in a manner that allows a resource manager to simultaneously consider all the ramifications involved in processing a single

officer assignment, not to mention the usual case of processing several officers simultaneously. The need for an interactive system that combines data retrieval and models to support the semi-structured decisions involved in officer assignments and career management strongly suggested the need for a decision support system.

An adaptive design approach to DSS was chosen because system requirements were not well defined at the outset of this thesis. Adaptive design offered the advantage of involving the users in the iterative design process in which a small kernel system is selected and allowed to grow and evolve as requirements are defined and change.

Identifying the Kernel

The technique of concept mapping was used to bound the problem, elicit requirements from the user, and help identify an initial anchor point. Additional requirements were obtained from ESC/DPQ in the form of answers to the subsidiary questions posed in Chapter I. Next, a set of storyboards were constructed to provide a visual representation of potential DSS screen displays. These storyboards were used to communicate the requirements gathered from the concept maps and questions back to ESC in the form of representations, operations, memory aids, and control mechanisms (ROMC). Appendix C contains the final set of storyboards that resulted from the evaluation and changes made by ESC/DPQ and DPR personnel through several iterations. As was shown in Figure 3.2, the end result of this iterative process is the definition of the kernel system.

While both DPQ and DPR personnel were very enthusiastic about building the DSS described by the storyboards, there were several fac-

tors that prohibited doing so at the time of this thesis:

1. ESC/DPQ had not identified a method of eliciting job requirements, nor committed themselves to actually building a data base of job descriptions.

2. Documentation of officer qualification and skill data beyond what was already available in the PDS depended upon ESC/DPQ compiling a comprehensive list of all ESC job requirements and evaluating ESC officer qualifications in terms of the list.

3. ESC/DPQ had not committed to building an ESC officer career plan for the major AFSCs utilized by ESC.

4. ESC personnel were unable to offer a consensus of what criteria to consider in an officer assignment decision, and could not provide a preference structure for the criteria discussed in Chapter V.

5. DPR personnel stated that a set of rules for a rule-based model to be used to evaluate an officer's career progression and provide assignment recommendations and career counseling advice would be too massive to be practical.

6. No off-the-shelf software was found that would sufficiently act as the dialog component for dBase III Plus, a rule-based model, and a linear programming package while providing the extensive windowing capabilities needed for the DSS.

Before a kernel DSS can be built, these six issues must be addressed. The following sections summarize proposed solutions to these issues and specific recommendations for building the DSS. These recommendations are consolidated in the form of a building plan in Figure 6.1.

Evaluation

As discussed in Chapter III, identifying DSS evaluation criteria before system construction not only helps the users decide what DSS to build, but also provides a basis for evaluating whether or not the DSS is a success. In short, evaluation criteria will help users and designers focus on why the DSS is being built, what it is supposed to do, and provide a standard to measure how well it does it. Although by no

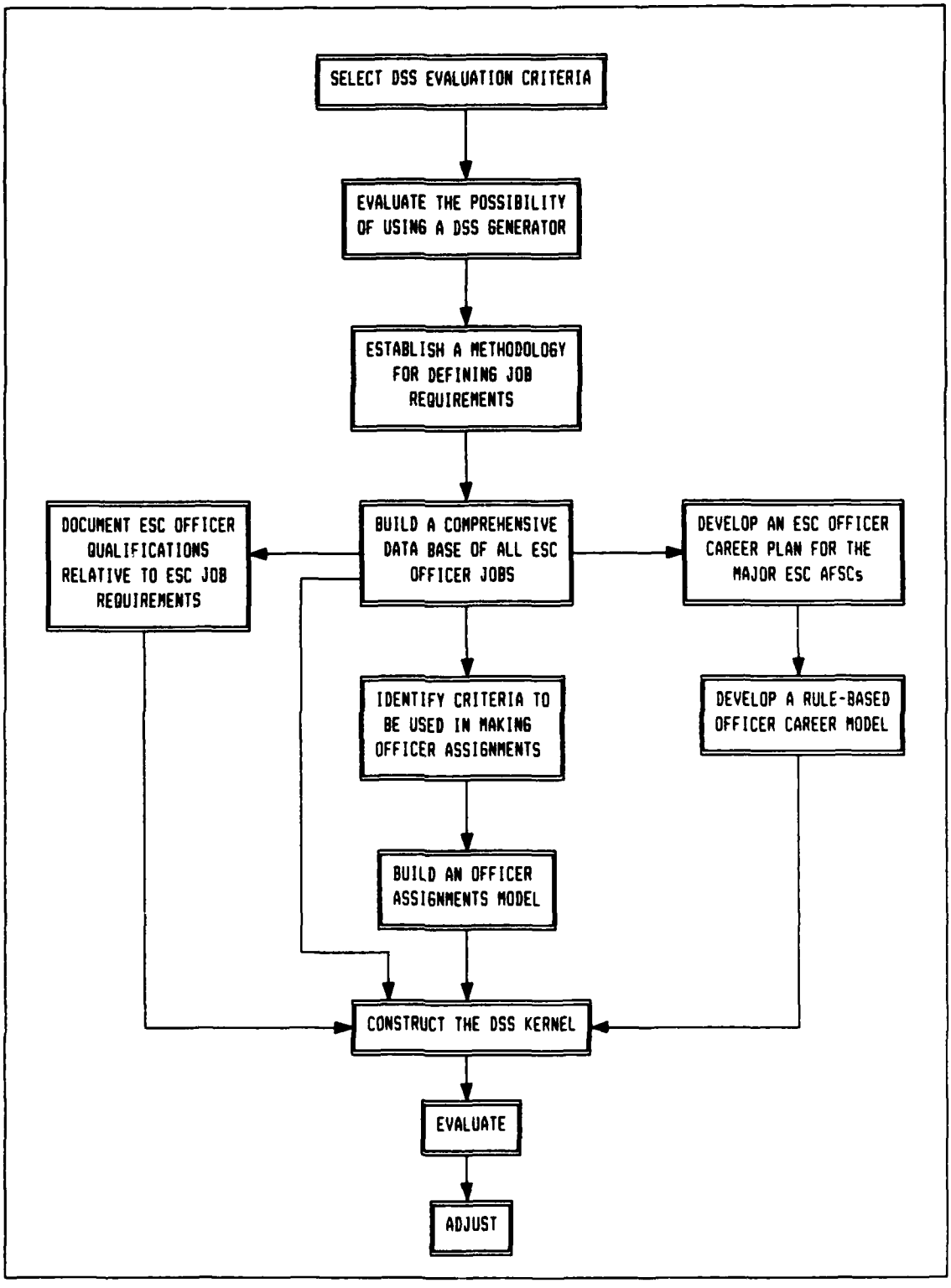


Figure 6.1 A Proposed Building Plan for the ESC DSS

means exhaustive, Table 4.1 offers some potential suggestions for evaluation criteria.

DSS Components

Chapters IV and V and Appendix C present a DSS design which provides ESC officer resource managers with:

1. Quick access to officer and job data bases needed to support the numerous phone calls from officers seeking assignment information.

2. A computerized notepad for documenting phone conversations and other various pieces of information gathered on each officer.

3. A rule-based career model to evaluate an officer's career progression and offer assignment recommendations and career counseling advice.

4. A method for scoring officers for jobs based on each officer's qualifications and career development needs.

5. A linear programming assignment model which provides job assignment recommendations by maximizing the sum of officer job qualification scores.

Specific capabilities must be developed in order to bring this DSS to fruition. These requirements are concisely documented in the Hookbook, Appendix D, where they are conveniently sorted by DSS component. The following subsections briefly discuss these requirements in light of the foundation laid in this thesis.

Job Data Base. ESC had not begun building the job data base at the time of this thesis. Before the data base can be built, ESC must decide how to characterize jobs and elicit job requirements. Chapter V addresses one method of characterizing job requirements and Appendix E provides a survey form that could be used to collect the information. Air Training Command's Occupational Measurement Center in conjunction with the Air Force Human Resources Laboratory have done extensive occu-

pational surveys and would be a good source of information for data collection techniques.

Officer Data Base. ESC is currently employing automation personnel to build the Tracker-Planner Automated System using dBase III Plus. The Officer Assignment and Career Planning DSS will require an officer data base with considerably more PDS data fields than are currently being used in the Tracker-Planner; however, these fields can easily be added to the current Tracker-Planner data base structure. The officer data base will also require additional fields for skills and qualifications not specifically identified in the PDS. A master list of job requirements must be compiled before assessing how many additional fields will be needed.

Rule-Based Model. A rule-based model would be extremely useful for comparing an officer's career progression against a career plan and providing assignment recommendations and career counseling advice. As noted in the thesis, ESC is not currently planning to develop a career plan for the officer force. Without a career plan, a resource manager can only offer generic career counseling and subjective assignment recommendations.

Assignments Model. A linear programming assignment model that selects officers for jobs based on an officer's qualifications for each job and the officer's skill development needs is presented in Chapter V. While the job requirement data base will provide a basis for assessing officer qualifications for jobs, an additional tool is necessary for assessing an officer's skill development needs. Two methods for assessing officer skill development needs were suggested in this thesis: 1) comparing each officer's career progress against an ESC career plan; and

2) using a simulation model to project ESC officer skill needs by AFSC and year group. Unless one of these capabilities is developed, officer skill development needs will continue to be determined subjectively by the resource manager.

While the linear programming assignment model does not select the "best qualified" officer for each job nor place an officer in a job that maximizes skill development needs, it does seek to trade-off these two criteria on an equally-weighted basis. This approach was selected as a result of ESC's inability to specify criteria preference and/or assignment goals. Goal programming and point estimate weighted-sums models are presented in Appendix F as viable alternatives to the assignment model approach. For more information on operations research modeling techniques, ESC may want to reference Hillier and Lieberman's text. For more information on multi-criteria decision modeling techniques ESC may want to reference Yu or Zeleny.

Dialog. The dialog component is perhaps the most important part of the DSS. In terms of ROMC, it provides the representations, operations, memory aids, and control mechanisms to support the decision process. ESC is currently developing the Tracker-Planner Automated System using dBase III Plus for the dialog component. While dBase III Plus has a good self-contained dialog capability, it cannot be used as an external higher-level dialog. It is recommended that ESC investigate the possibility of using a DSS generator, which is an integrated package that "provides a set of capabilities to build specific DSS quickly and easily" (Sprague, 1982:11). ESC may want to reference Walker or Sprague and Carlson for more information on DSS generators.

Conclusion

Success of the ESC Officer Force Development Program depends on ESC's ability to accurately define job requirements, classify officers, and select the "best qualified" officers for each assignment while insuring that officers are developing the necessary skills to provide ESC with a pool of professionally-developed and technically-qualified officers to meet the future needs of ESC. This thesis specifically addressed each of these issues and provided a solid foundation upon which ESC can begin building a DSS to support their officer resource managers. This foundation consists of:

1. System requirements that were elicited from ESC resource managers through the process of concept mapping and are presented in the form of screen display storyboards.

2. A methodology for classifying job requirements in terms of mandatory, desired, and skill development criteria and a survey that can be used to collect and weight criteria factors.

3. Suggestions of how to build an officer career plan and a rule-based model for evaluating officer career progression.

4. Suggested criteria to be used in making officer assignment decisions.

5. A method of selecting the "best qualified" officer for each assignment through a scoring process in which officer qualifications are compared to job requirements.

6. A method of placing officers in jobs that develop necessary skills for future jobs in ESC through a similar scoring process.

7. A linear programming assignments model that makes officer assignment recommendations based on officer qualification and skill development scores.

8. Suggested DSS evaluation criteria.

9. A Hookbook of specific suggestions for developing each of the DSS components.

The foundation has been laid and a building plan has been provided. It is now up to ESC to begin construction.

APPENDIX A

PROBLEM DEFINITION

This appendix defines some of ESC's force management problems and some proposed solutions as identified through discussions with ESC personnel in the early stages of problem identification. This information was used to scope the research effort into a thesis-sized problem. This appendix presents the issues as seen from the perspective of the command, the resource manager, and the individual officer/supervisor.

TABLE A.1

ESC Personnel Issues

Present ESC Problems	Possible Solutions
1. Loss of experienced personnel -specifically 2825s	A. Develop a system to track ESC "assets" while they are on tours outside of ESC B. Define which job assignments require prior ESC experience and state these requirements to MPC C. Develop a career-broadening program that sends individuals to other MAJCOMS with the requirement of returning to ESC on the follow-on assignment D. Create an "atmosphere" that makes officers want to return to ESC on subsequent tours
2. Jobs are not being filled with the best-qualified individuals	A. Identify specific job requirements and individual qualifications. Develop a model to match personnel experience to job requirements B. Maintain a prioritized list of individuals for each job in order to provide resource managers with the most qualified individuals for each job C. Stay ahead of MPC in the assignments process and provide detailed justification for each individual requested
3. An automated force management system to help insure the development of a highly-qualified pool of experienced individuals for future ESC requirements does not exist.	A. Define the pool of highly-qualified individuals by specialty area, grade, and experience required B. Define career management and assignment guidelines for each personnel specialty area C. Develop a simulation model to predict future ESC force requirements and provide planning and assignment guidance

Table A.2

ESC Resource Manager Issues

Resource Manager Problems	Possible Solutions
1. Inundated with phone calls	A. Make the most frequently requested information available to officers in the field B. Provide quick and easy access to PDS information, lists, and requirements by automating on a PC C. Automate the recording and filing of notes taken on officer phone calls D. Use less-skilled personnel to answer basic phone questions
2. Lack of specific information regarding job requirements	A. Document and automate specific requirements for all critical positions (list could include minimum level and desired level of expertise) B. Develop a model to choose the best qualified persons for each job
3. Lack of specific officer experience and qualification information	A. Document and automate officer experience B. Develop a model to choose the best job for each person's career
4. No system exists to trade-off an assignment that is best for a person's career, best match for mission accomplishment, or best assignment for developing skills for future force requirements	A. Develop a multi-criteria, AHP, or goal programming model to allow weighting/prioritizing of factors
5. Some personnel are assigned the job of resource manager without any prior personnel experience	A. Develop a prescriptive decision aid with training and help functions built in to help the "novice" make assignments

Table A.2

ESC Resource Manager Issues (cont)

6. Lists, requirements, records, and regulations are all browsed manually	A. Automate as much as possible on a PC B. Develop a decision aid that screens and presents only the information of value in a form to aid in the decision process
7. Personnel outside of ESC are not available through the PDS	A. Develop a system to track personnel when they leave ESC B. Personally contact these individuals prior to their next assignments and provide assignment opportunities in ESC
8. Resource managers have a difficult time describing the decision process for making assignments	A. Develop specific career guidelines for each specialty area and incorporate these guidelines in the decision aid

Table A.3

Officer/Supervisor Issues

Officer/Supervisor Problems	Possible Solutions
1. Specific Career Guidance is not provided for career management, assignment projection, and career counciling	A. Develop specific career guidance for each AFSC that tells an officer where he should be and where he needs to go
2. Specific assignment information is not available for filling out the AF Form 90 and career planning	A. Make specific job information available to each officer that allows him/her to assess if: (1) Qualified for the job (2) Job is/will be available at time of PCS (3) Job fits career plan (4) Job will develop some desired area of expertise

APPENDIX B

CONCEPT MAP

This appendix presents a concept map of the ESC resource manager officer assignment and career counciling arena. The concept map is divided into 2 separate pages due to limitation of space. The resource manager block, highlighted in the heavier-outlined box, is the tie between the 2 pages.

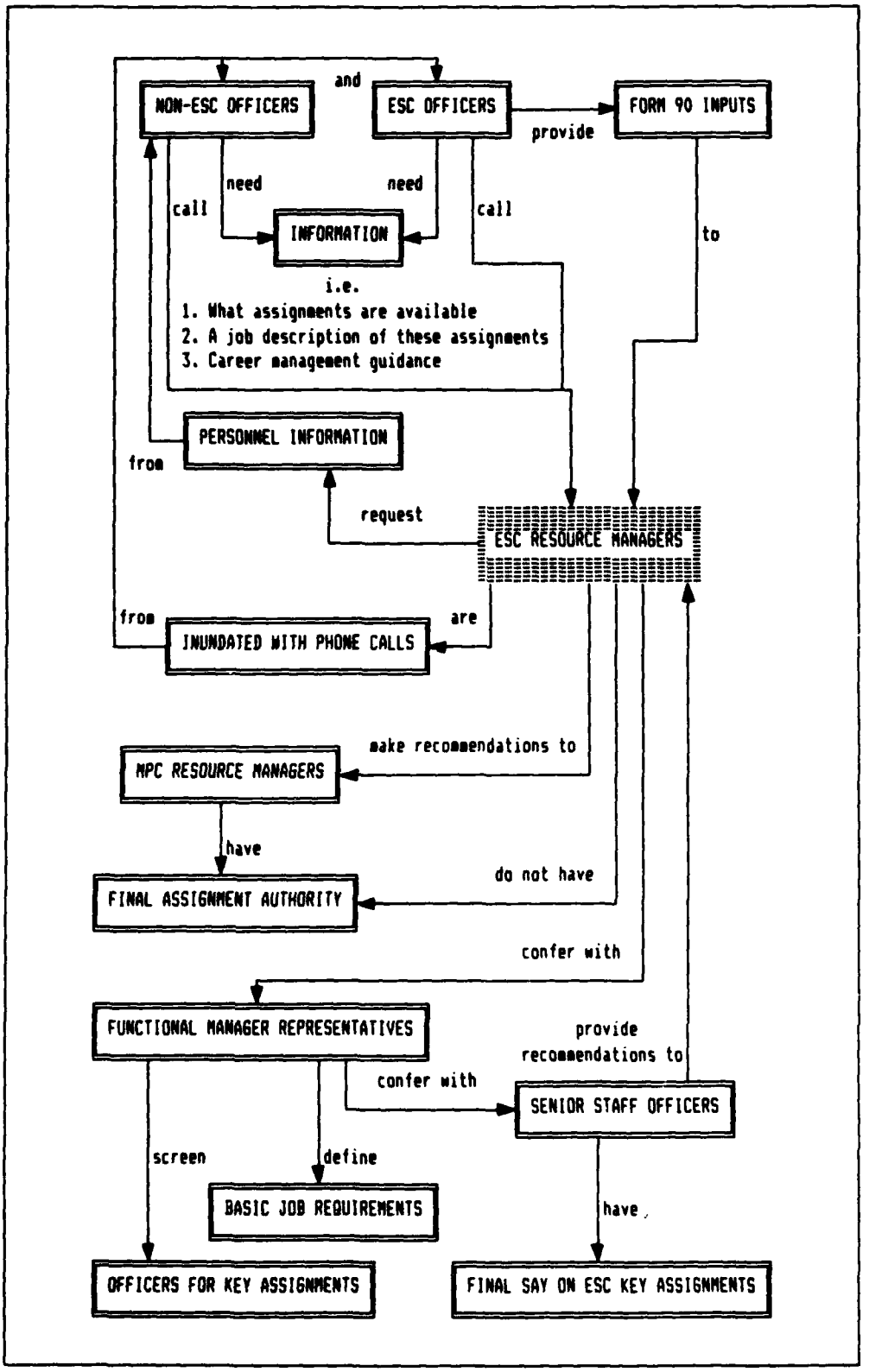


Figure B.1 Resource Manager Interaction with Key Individuals

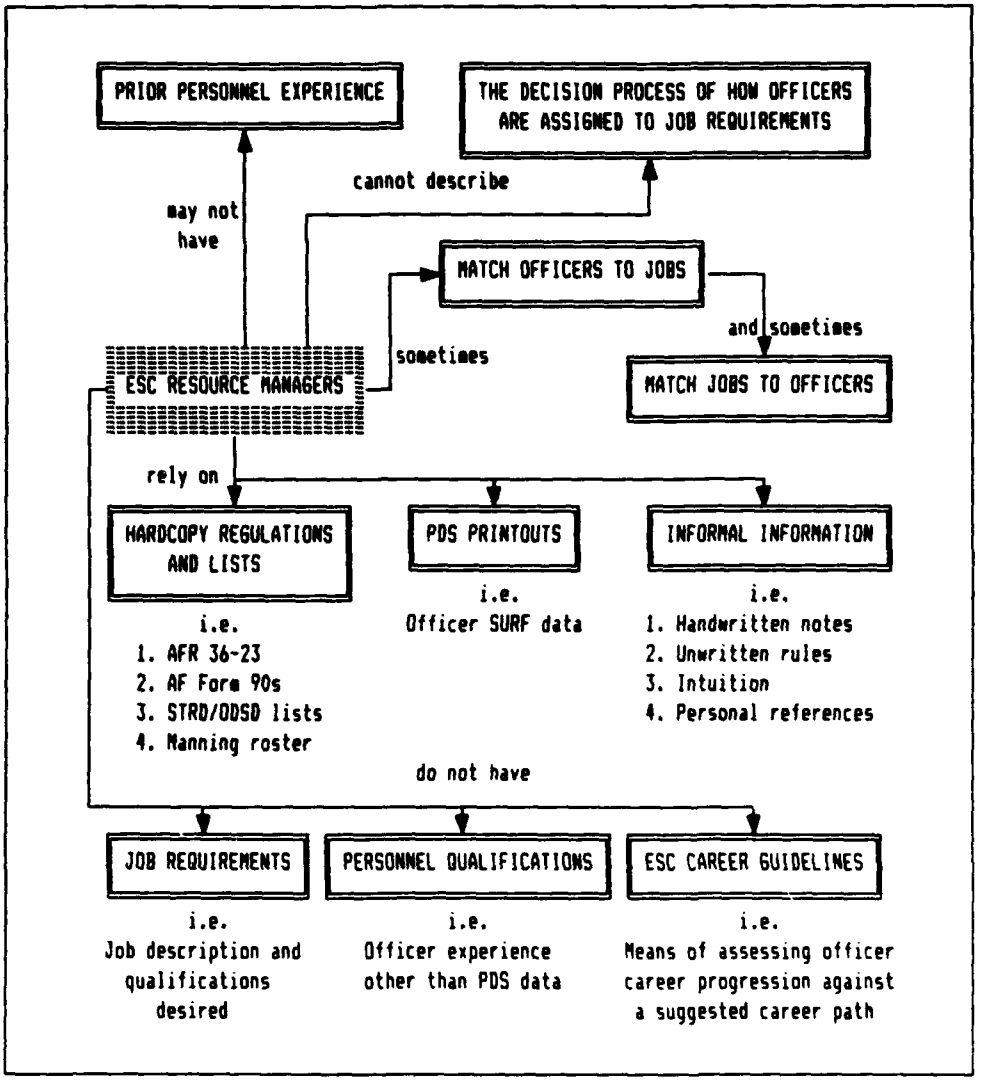


Figure B.2 Resource Manager Decision-Making Environment

APPENDIX C

FEATURE CHART AND STORYBOARDS

The storyboards in this appendix are the final results of several iterations with ESC/DPQ and DPR personnel. These storyboards provide a statement of officer resource manager requirements. Since the storyboards were designed using Sprague and Carlson's ROMC approach as a checklist, the help screens display information in the form of Representations, Operations, Memory Aids, and Control Mechanisms. The help screens are introduced with a Requirements section that explains the particular ESC needs addressed by that screen. A feature chart proceeds each storyboard sequence to show screen connectivity and where models are needed to support screen displays.

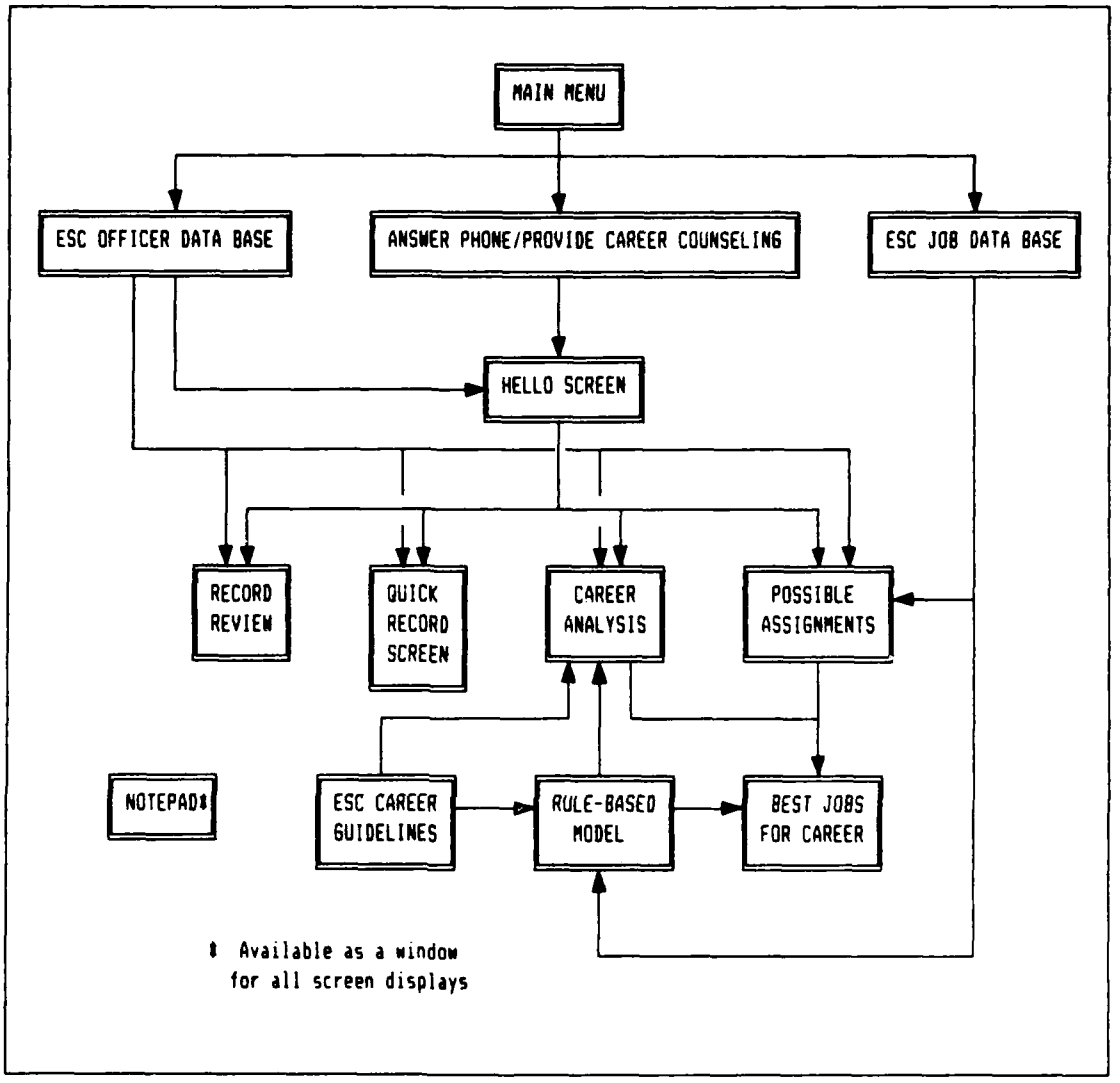
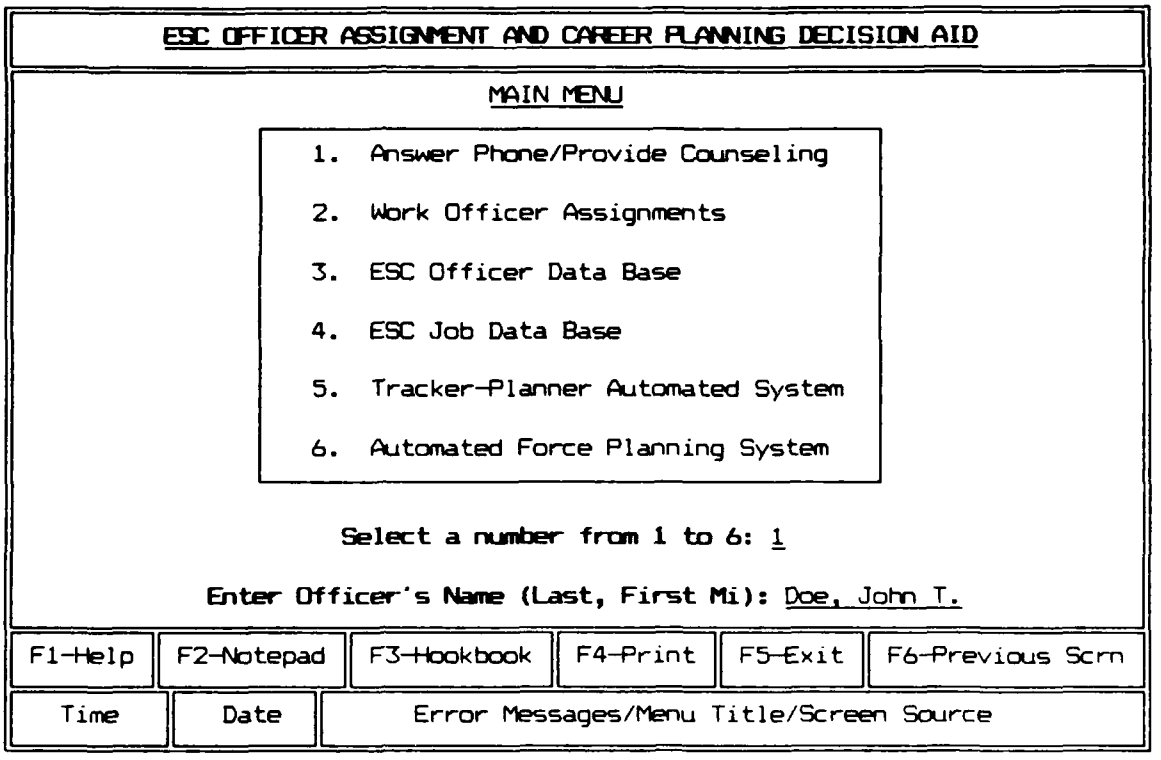
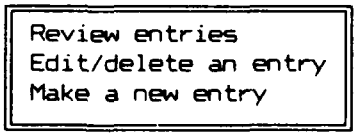
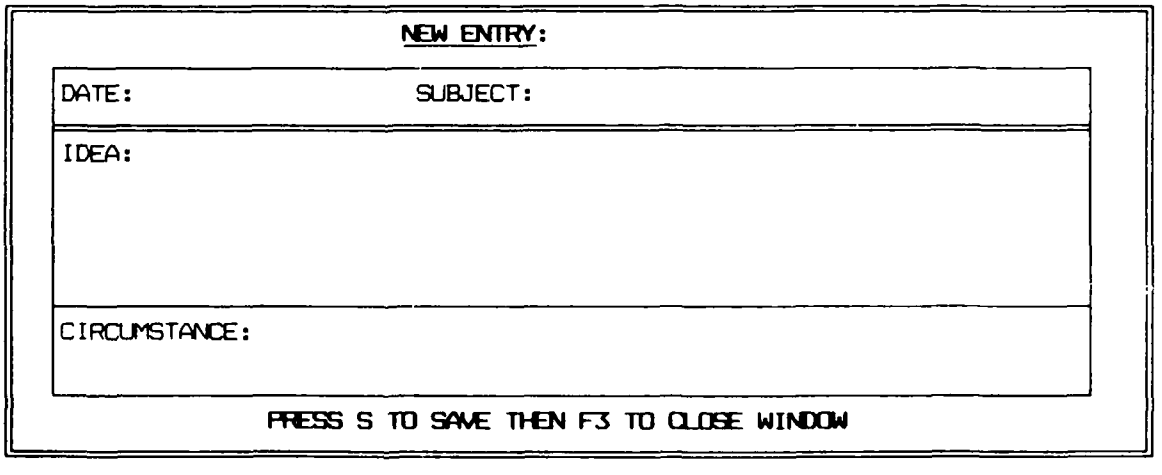


Figure C.1 Answer Phone/Career Counseling Feature Chart



F3-Hookbook window option:





HELP

REQUIREMENTS: ESC Resource Managers require access to officer personnel data, job data, career counseling information, the Tracker-Planner Automated System (currently being designed by DPQ), the Automated Force Planning System (when built by DPQ), models to help the career planning and assignments, and the capability to permanently record important information in a note file.

REPRESENTATIONS: The Main Menu displays the 6 main options open to the user.

OPERATIONS: For option #1, the calling officer's file is retrieved to support the next screen display.

MEMORY AIDS: The F1 key provides a memory aid for the control mechanisms and operations through the help function. The F2 key provides a memory aid for any information recorded while talking to an officer or reviewing his/her record. The F3 key provides a memory aid for any ideas about how to improve or change the DSS. The F4 key provides a memory aid in the form of saving information or printing a hard copy. The F6 key provides a short-term memory aid by returning the user to the previous screen. The function keys are defined for the user at the bottom of each screen. Additionally, the date, time, name of screen, and screen source are provided at the bottom of each screen. User is given the format for entering a menu choice, and an officer's name.

CONTROL MECHANISMS: The user selects an option by entering a number. If option #1 is chosen, the user is prompted for the calling officer's name.

Function Keys

F1-Help: Displays this page

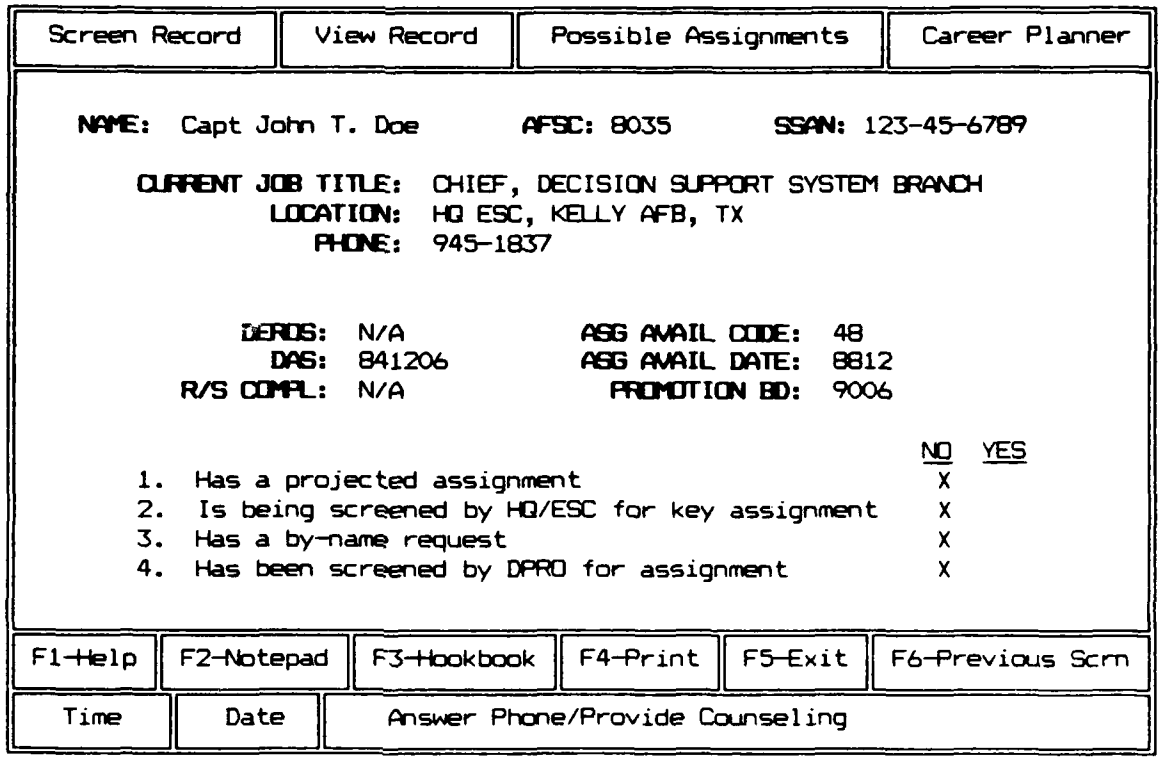
F2-Notepad: Opens a window to allow comments on an officer to be viewed, entered, or edited

F3-Hookbook: Opens a window to allow hookbook entries to be viewed, entered, or edited

F4-Print: Provides a hard copy capability through print screen or file capability. Also provides the capability of saving model runs to a file.

F5-Exit: Provides the capability of returning to the operating system

F6-Previous Screen: Provides the capability of backing up in screen sequence



Pull Down Menus/Options:

Screen Record	View Record	Possible Assignments	Career Planner
see C-7	Duty History Training/PME/ Education Form 90 Entire Record	Days from DEROS/AAD 1. ±30 2. +30/-60 3. +30/-90 4. select window	View Qualifications View Career Guidelines Career Analysis Assignment Recommendations

Window Options:

1-4: Provides a Text window to explain a "Yes"

HELP

REQUIREMENTS: ESC Resource Managers need information from an officer's data file to build some rapport with the caller, determine when the officer will be eligible for reassignment, and whether there is any pending assignment action on the officer.

REPRESENTATIONS: This screen displays the some basic officer record data base fields and text interpretation of pending assignment data base field codes.

OPERATIONS: A data base programming subroutine screens the pending assignment fields and displays a no or yes answer to the 4 possible assignment actions.

MEMORY AIDS: Include pull-down windows, function-key definitions, and screen record option.

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then Enter.

	View Record	Possible Assignments	Career Planner

		NO	YES
CAPT JOHN DOE:	1. HAS A UIF	X	
	2. HAS A DIGEST FILE	X	
	3. IS ON THE WEIGHT CONTROL PROGRAM	X	
	4. HAS OERs BELOW BLOCK 1	X	
	5. HAS BEEN PASSED OVER	X	
	6. HAS AN ASSIGNMENT LIMITATION CODE	X	
	7. HAS A JOINT SPOUSE	X	
	8. HAS A SERVICE COMMITMENT	X	

SECURITY CLEARANCE: TS CLEARANCE DATE: 800922
TYPE: SBI PRP/SCI: N/A

ODSD: 780607 MARITAL STATUS: MARRIED
STRD: 7806 DEPENDENTS: 5

F1-Help	F2-Notepad	F3-Hookbook	F4-Print	F5-Exit	F6-Previous Scrn

Time	Date	Screen Record

Window options:

1-8: Provides a text window to explain a "yes"

F2-Notepad:

NOTE FILE ON CAPT JOHN T. DOE, 123-45-6789	
5 APRIL 88	Doe called and provided a verbal change to his FM 90. He wants to go to Germany. Capt Bill Smith is in position # 0050654 at Ramstein and will PCS in time for Doe to take the job. CM
15 APRIL 88	Talked to MPC, Doe is tagged for SAC. JT
19 APRIL 88	Doe called back. He is working on a 4 star by-name request to Ramstein. CM
22 JUNE 88	New phone extension is X1875

PRESS F5 TO CLOSE WINDOW

HELP

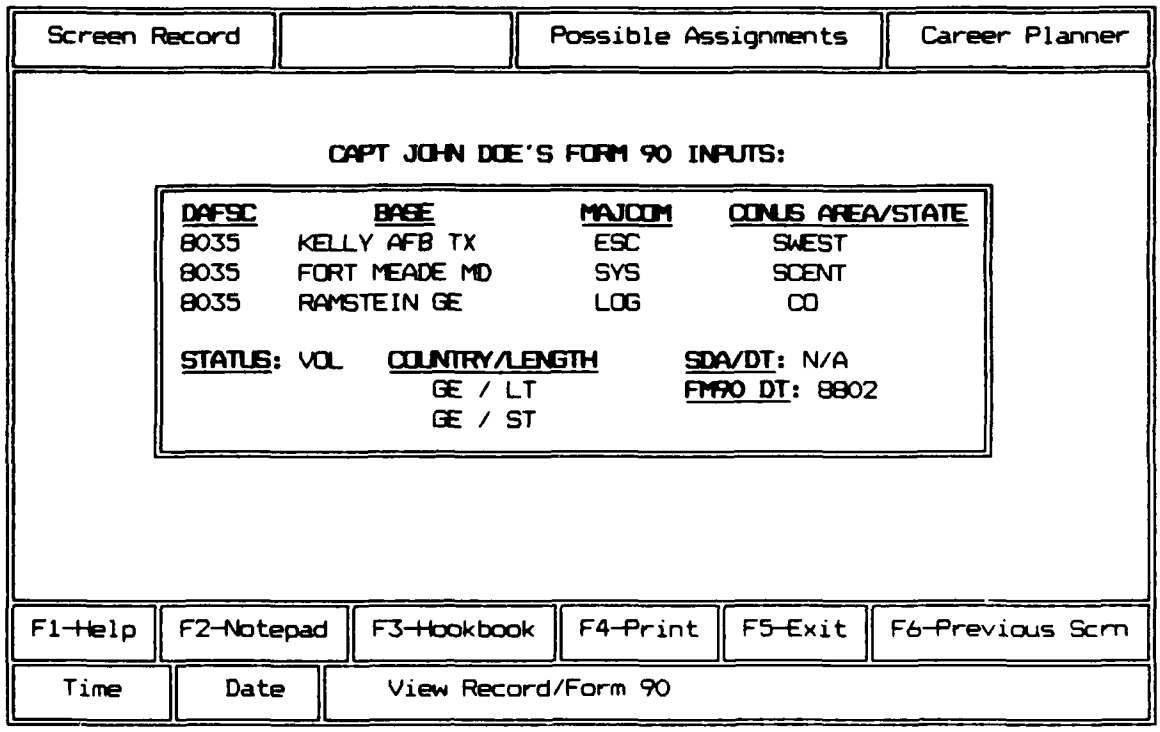
REQUIREMENTS: ESC Resource Managers need to know if there are any "glaring" problems in an officer's record or special factors to be considered before proceeding with a counseling session.

REPRESENTATIONS: Six potential problems and two special considerations are summarized in a simple yes or no table. Three other special considerations summarized by presenting the actual data base fields.

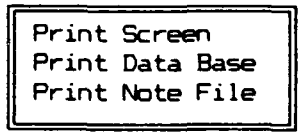
OPERATIONS: A data base programming subroutine screens the eight fields for the table entries and displays a yes or no summary.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then **Enter**.



F4-Print window option:



HELP

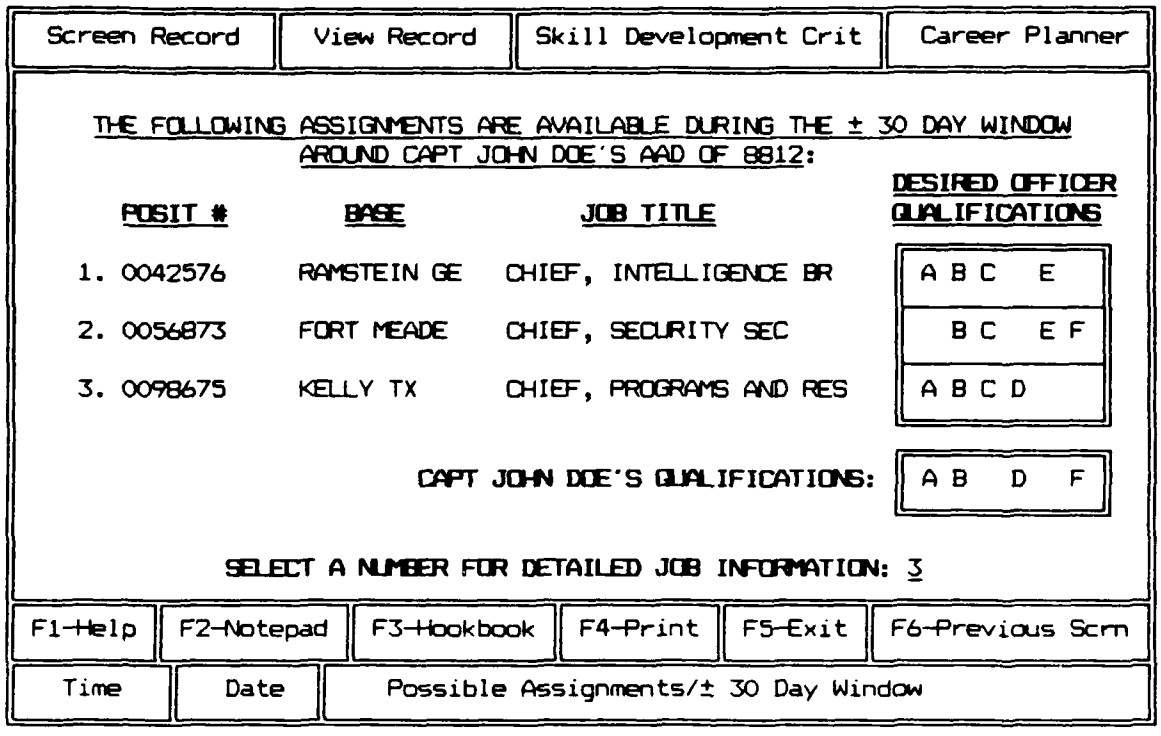
REQUIREMENTS: ESC Resource Managers need access to an officer's entire personnel record to verify information or browse for additional information. Due to the amount of information contained in the record, the resource managers need the capability to specify which sections of data are displayed.

REPRESENTATIONS: Data base fields requested by the menu.

OPERATIONS: User selects what data is displayed.

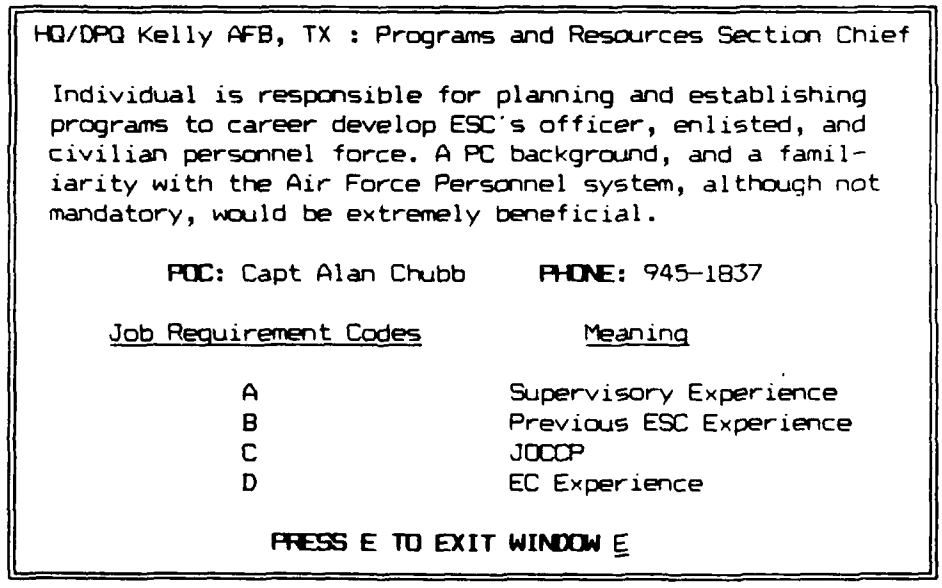
MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select a window by using arrow keys and then **Enter**. A menu option is chosen by using the arrow keys and then **Enter**.



Window Options:

Numbers proceeding jobs:



HELP

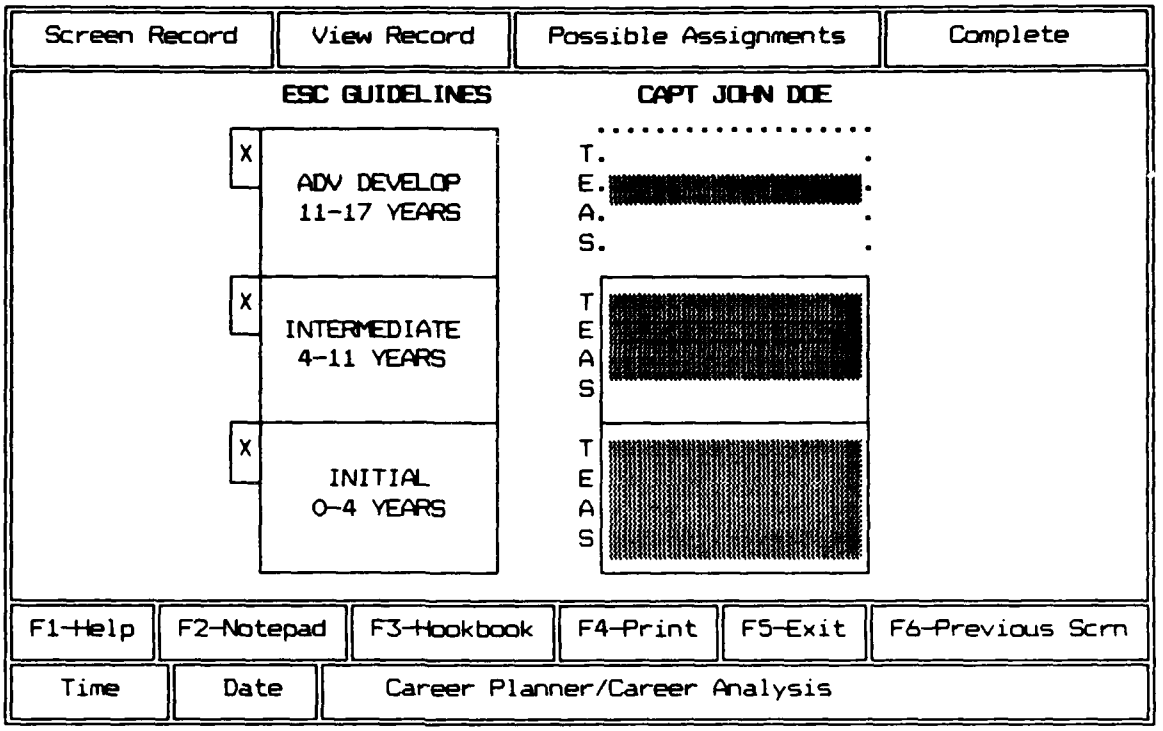
REQUIREMENTS: ESC Resource Managers need the capability of being able to pull up possible assignments that may be available during the calling officer's PCS window. Once ESC/DPQ establishes the job requirements for each job, and qualification codes for each officer, the resource managers will need to compare these codes to determine to what degree the officer is qualified for the jobs displayed. It should be noted that resource managers will use this information for counseling only and do not require the use of a qualification matching model here. Officers and resource managers also need more information on what each job entails than merely a job title and location.

REPRESENTATIONS: Jobs that are or will become vacant during the period of time chosen by the user and for which the officer meets the mandatory requirements are displayed. Desired officer qualification codes and the officer's qualifications are alpha-numeric representations of specific experiences established by ESC/DPQ. A window option provides specific information on each job and an explanation of the alpha-numeric codes. An additional window is available for displaying the skill development criteria for each job so the resource manager can assess the career development impact of each assignment.

OPERATIONS: Job displays are the result of a data base sort routine generated for the period of time chosen by the user. Selecting a specific job invokes a data retrieval for more detailed information.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select a window by using arrow keys and then **Enter**. A menu option is chosen by using the arrow keys and then **Enter**. To window on a job, merely enter the number proceeding the job of interest.



Window Options:

"Click" on Phases:

ESC Career Guidelines

YEAR	PHASE	GRADE	TRAINING	EDUCATION	ASSIGNMENTS	SKILL DEVELOPMT
4-11	INTER-MEDIATE	CAPT				

Capt John Doe's Career Progression

YEAR	PHASE	GRADE	TRAINING	EDUCATION	ASSIGNMENTS	SKILL DEVELOPMT
4-11	INTER-MEDIATE	CAPT				

HELP

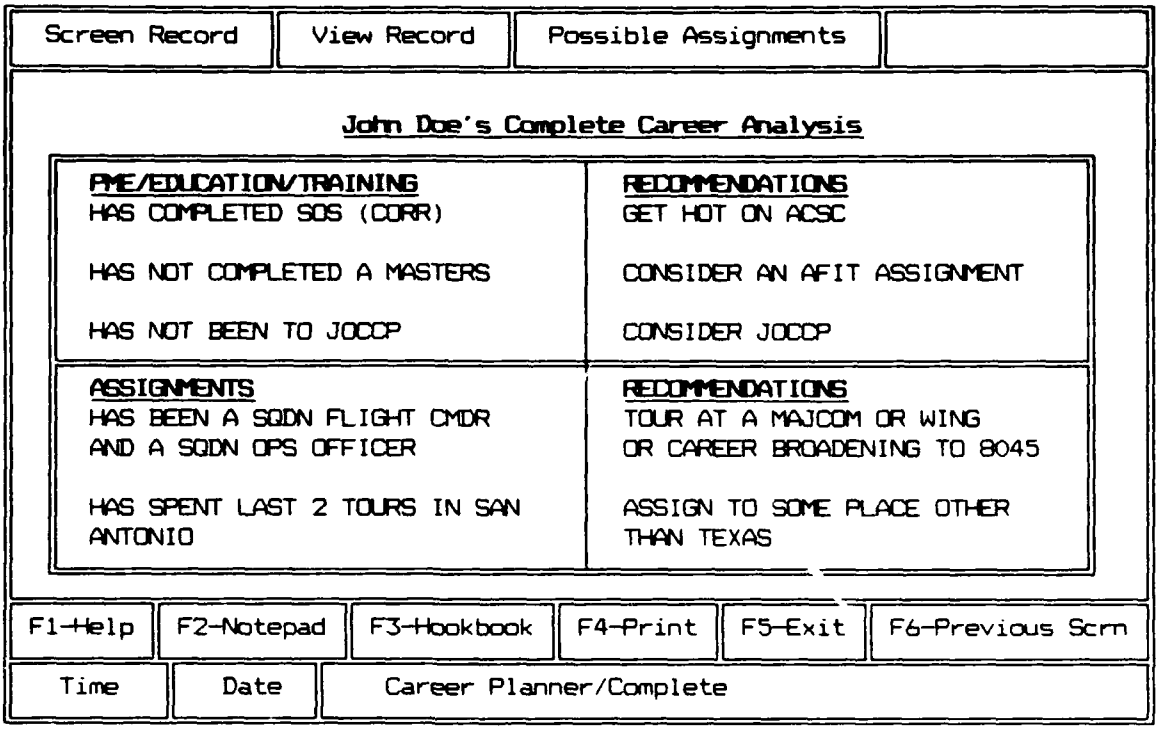
REQUIREMENTS: In order to provide career counseling, ESC Resource Managers require a standard from which to evaluate an officer's accomplishments and make recommendations for further career progress.

REPRESENTATIONS: Screen display is a pseudo bar graph that compares an officer's accomplishments with a career standard. Shaded areas represent completion, non-shaded areas represent career objectives still needing to be met. A solid outline indicates present and previous career phases, while a broken outline indicates future phases. There are 4 career development factors displayed: T-Training, E-Education, A-Assignments, and S-Skill development. Window representations show an ESC career phase objective with the officer's career progression in text form.

OPERATIONS: The career analysis option invokes a rule-based model (perhaps an expert system) that analyzes an officer's career by comparing his/her data file with the career standard. A simple screen graphic routine is invoked to display the representation. Selecting a career phase invokes a data retrieval on the officer's record and the career guide.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select a window by using arrow keys and then **Enter**. A menu option is chosen by using the arrow keys and then **Enter**. To window on a career phase, select the phase using the arrow keys and then **Enter**.


Screen Record
View Record
Possible Assignments
John Doe's Complete Career Analysis
PME/EDUCATION/TRAINING
HAS COMPLETED SOS (CORR)
HAS NOT COMPLETED A MASTERS
HAS NOT BEEN TO JOCCP
RECOMMENDATIONS
GET HOT ON ACSC
CONSIDER AN AFIT ASSIGNMENT
CONSIDER JOCCP
ASSIGNMENTS
HAS BEEN A SQDN FLIGHT CMDR AND A SQDN OPS OFFICER
HAS SPENT LAST 2 TOURS IN SAN ANTONIO
RECOMMENDATIONS
TOUR AT A MAJCOM OR WING OR CAREER BROADENING TO 8045
ASSIGN TO SOME PLACE OTHER THAN TEXAS
F1-Help
F2-Notepad
F3-Hookbook
F4-Print
F5-Exit
F6-Previous Scrn
Time
Date
Career Planner/Complete

HELP

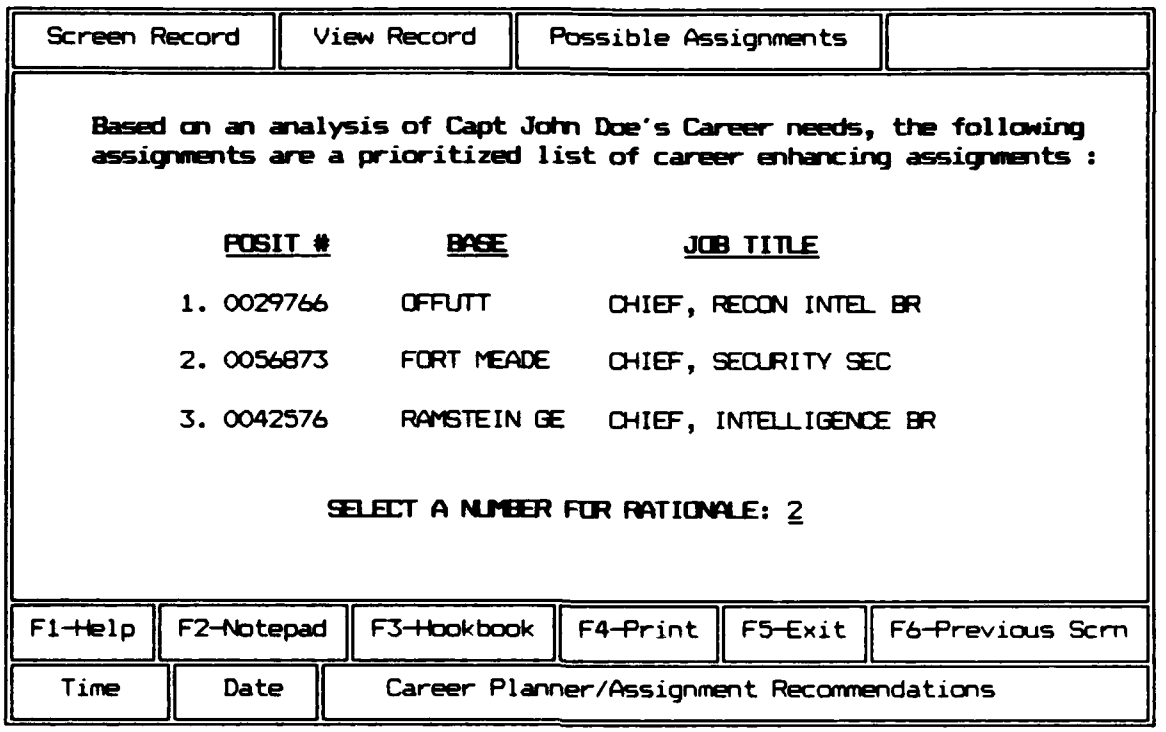
REQUIREMENTS: In order to provide career counseling, ESC Resource Managers require a standard from which to evaluate an officer's accomplishments and make recommendations for further career progress. A career screening model is needed that will make assignment recommendations based on the officer's accomplishments.

REPRESENTATIONS: Screen display is a text summary of the model results in the form of the officer's accomplishments and what the officer needs for further career progression.

OPERATIONS: The career analysis option invokes a rule-based model (perhaps an expert system) that analyzes an officer's career by comparing his/her data file with the career standard and making assignment recommendations based on an established set of rules.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select a window by using arrow keys and then **Enter**. A menu option is chosen by using the arrow keys and then **Enter**.



Window Options:

Numbers proceeding jobs:

SAC/IN Offutt AFB, NE: Reconn Intelligence Branch Chief

1. Capt J. Doe needs a tour at a wing or MAJCOM:
   This tour is a MAJCOM tour
2. Capt J. Doe needs an assignment outside of Texas:
   This tour is in Nebraska
3. Capt J. Doe needs to attend school XYZ for the 11-17 year phase:
   This tour will provide training at school XYZ
4. Capt J. Doe has an exact experience match with job requirements
   making it the most suitable job of those available

HELP

REQUIREMENTS: Based on the analysis of an officer's career, the ESC Resource Managers need to be able to recommend which assignments offer the greatest career enhancement.

REPRESENTATIONS: Screen display is a prioritized list of job assignments based on the output of a rule-based model or expert system. A window option provides a text screen of the reasons behind each choice.

OPERATIONS: Invoking the Assignment Recommendations option from the career planner screen runs the list of assignments that will available during the user selected dates through a rule-based model or expert system which prioritizes them according to the officer's career needs.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select a window by using arrow keys and then **Enter**. A menu option is chosen by using the arrow keys and then **Enter**. Rationale for a particular assignment is provided by selecting the number proceeding the job.

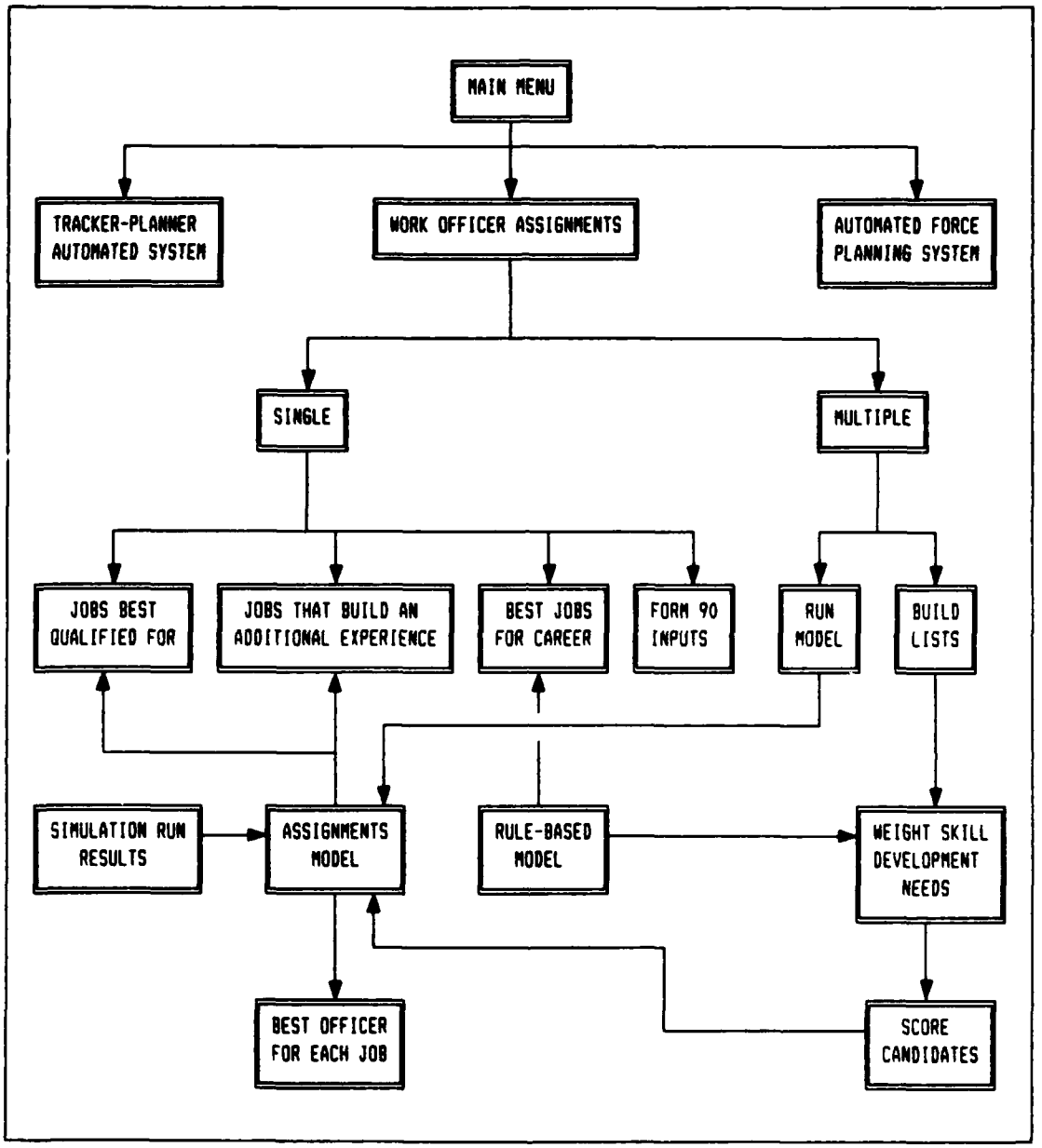
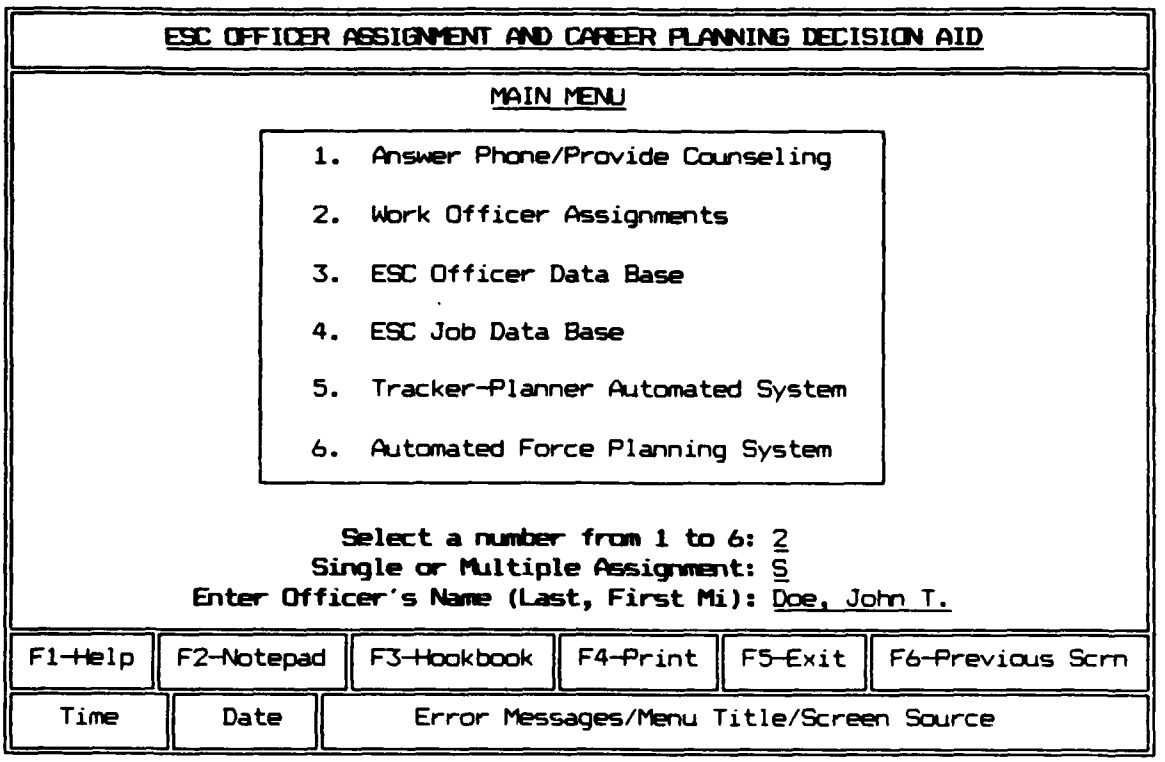


Figure C.2 Work Assignments Feature Chart


ESC OFFICER ASSIGNMENT AND CAREER PLANNING DECISION AID
MAIN MENU
1. Answer Phone/Provide Counseling
2. Work Officer Assignments
3. ESC Officer Data Base
4. ESC Job Data Base
5. Tracker-Planner Automated System
6. Automated Force Planning System
Select a number from 1 to 6: 2
Single or Multiple Assignment: S
Enter Officer's Name (Last, First Mi): Doe, John T.
F1-Help
F2-Notepad
F3-Hookbook
F4-Print
F5-Exit
F6-Previous Scrn
Time
Date
Error Messages/Menu Title/Screen Source

HELP

REQUIREMENTS: ESC Resource Managers need a better method of matching officer experience to job requirements while taking into account the overall impact of each decision on the officer's career and the force development needs of ESC. An assignment decision may involve only one officer or a group of officers.

REPRESENTATIONS: This screen is a duplication of the main menu with option 2 selected.

OPERATIONS: Upon entering selection 2 and the single assignment choice, the user is prompted for the name of the officer to be assigned.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: The user selects an option by entering a number. If option #2 is chosen, the user is prompted for the type of problem to be solved (S or M). If S is chosen, the user is prompted for the officer's name.

Function Keys

F1-Help: Displays this page

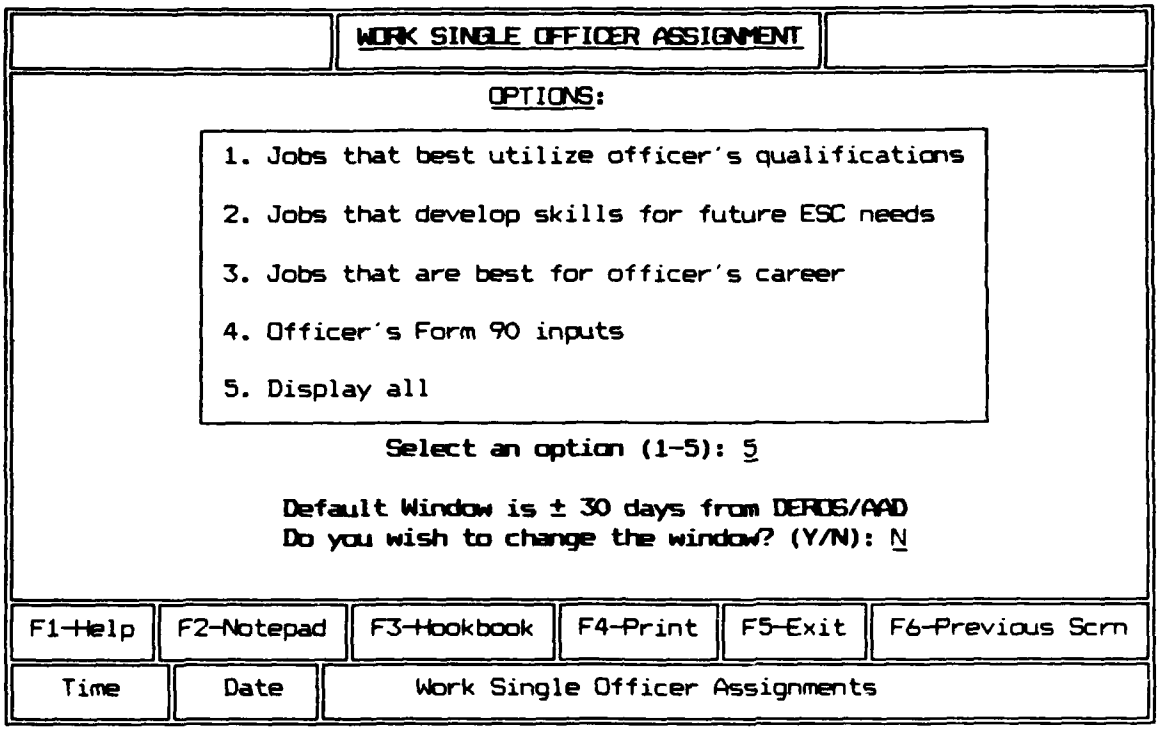
F2-Notepad: Opens a window to allow comments on an officer to be viewed, entered, or edited

F3-Hookbook: Opens a window to allow hookbook entries to be viewed, entered, or edited

F4-Print: Provides a hard copy capability through print screen or file capability. Also provides the capability of saving model runs to a file.

F5-Exit: Provides the capability of returning to the operating system

F6-Previous Screen: Provides the capability of backing up in screen sequence


WORK SINGLE OFFICER ASSIGNMENT
OPTIONS:
1. Jobs that best utilize officer's qualifications
2. Jobs that develop skills for future ESC needs
3. Jobs that are best for officer's career
4. Officer's Form 90 inputs
5. Display all
Select an option (1-5): 5
Default Window is ± 30 days from DEROS/AAD
Do you wish to change the window? (Y/N): N
F1-Help
F2-Notepad
F3-Hookbook
F4-Print
F5-Exit
F6-Previous Scrn
Time
Date
Work Single Officer Assignments

HELP

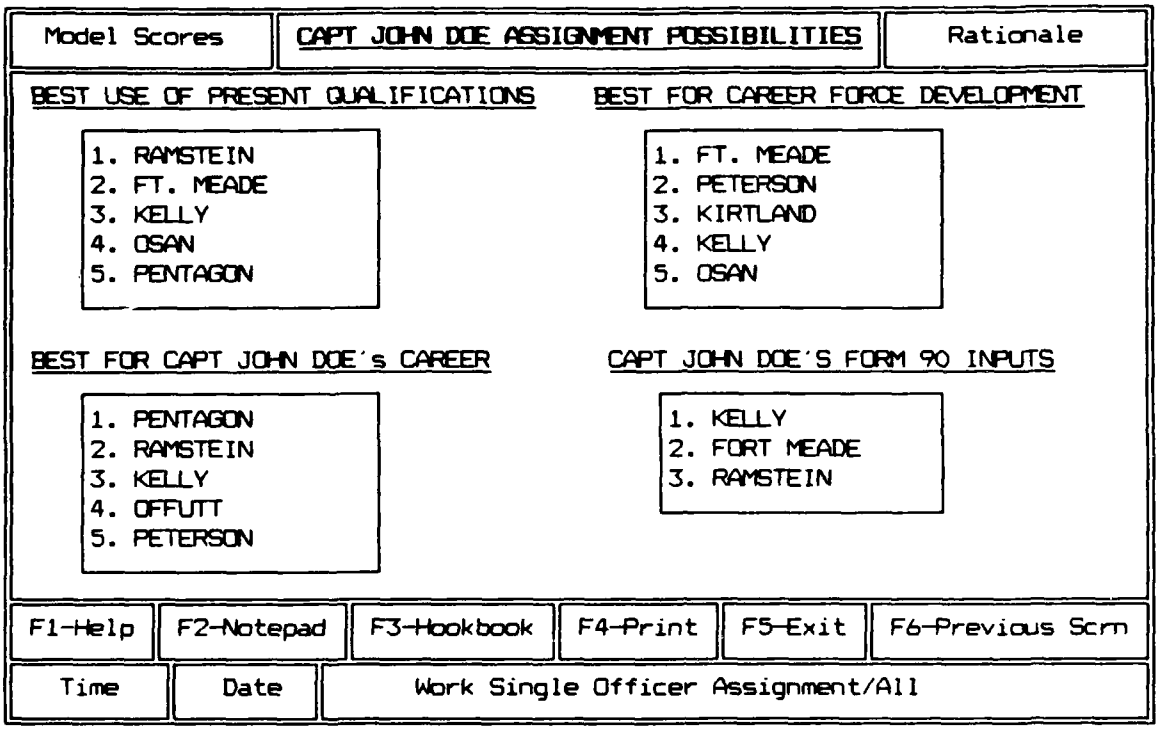
REQUIREMENTS: ESC has not been able to specifically define criteria for making an officer assignment. This storyboard summarizes some suggested criteria that could be used in making an assignment.

REPRESENTATIONS: The Main Menu displays the 5 main options open to the user.

OPERATIONS: This screen requires the invoking of the officer's data file to produce the Form 90 inputs, the running of a rule-based model to produce the list of assignments best for the officer's career, an assignments model to prioritize jobs based on the officer's experience (discussed in the following storyboards), and the running of the assignments model based on future career needs of ESC. The user is prompted for the date windows of interest which invokes a data base sort of jobs available for assignments.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then Enter.



Window Options:

Model Scores: Provides window with Assignment model scores

Rationale: Provides window like one in career assignment recommendations

HELP

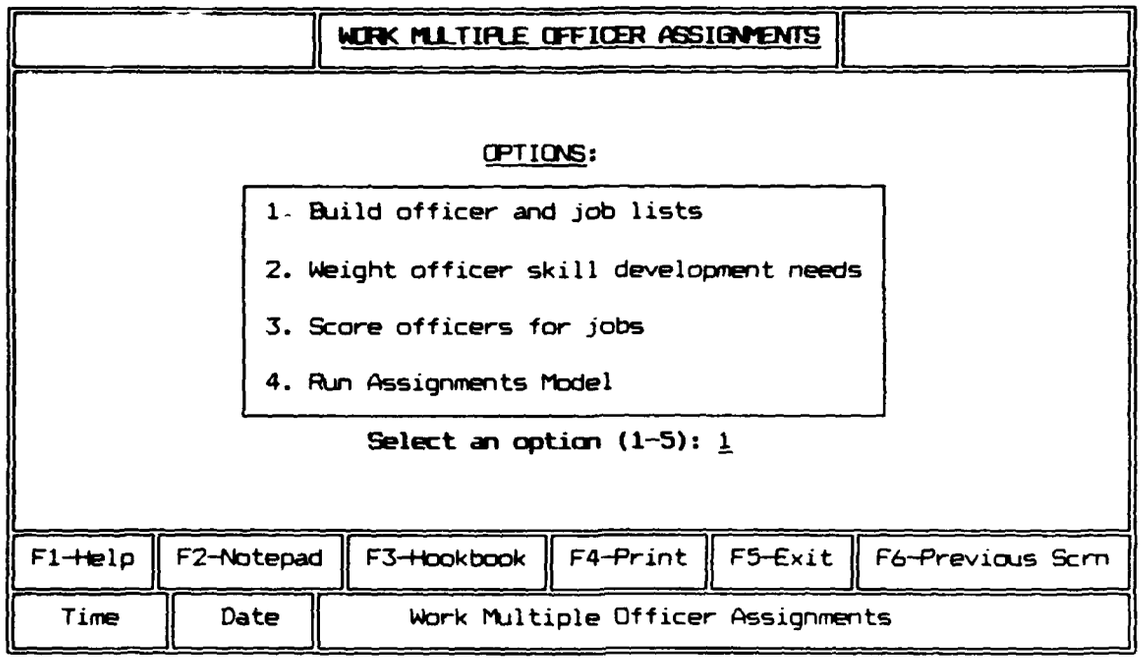
REQUIREMENTS: ESC has not been able to specifically define criteria for making an officer assignment. This storyboard summarizes some suggested criteria that should be used in making an assignment.

REPRESENTATIONS: A prioritized list of jobs satisfying each criteria is presented in list form. The Rationale option provides the reasoning behind a "best" for the officer's career choice in a window as already shown in the Career Planner storyboard. The Model Scores option provides the "rationale" behind the jobs listed in the top two criteria.

OPERATIONS: This screen requires the invoking of the officer's data file to produce the Form 90 inputs, the running of a rule-based model to produce the list of assignments best for the officer's career, an assignments model to prioritize jobs based on the officer's experience (discussed in the following storyboards), and the running of the assignments model based on future career needs of ESC.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then Enter.


WORK MULTIPLE OFFICER ASSIGNMENTS
OPTIONS:
1. Build officer and job lists
2. Weight officer skill development needs
3. Score officers for jobs
4. Run Assignments Model
Select an option (1-5): 1
F1-Help
F2-Notepad
F3-Hookbook
F4-Print
F5-Exit
F6-Previous Scrn
Time
Date
Work Multiple Officer Assignments

HELP

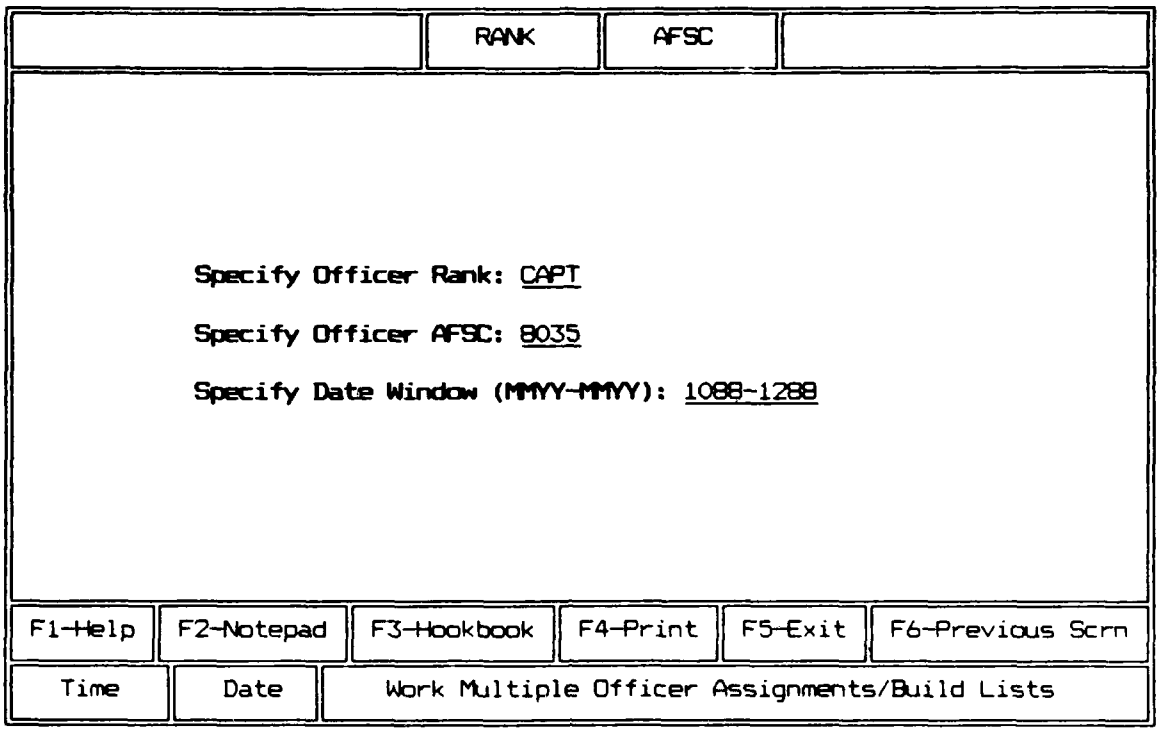
REQUIREMENTS: For the majority of cases, ESC Resource Managers are faced with assigning a pool of officers available for assignment to a pool of available jobs. The resource manager needs to identify the officers who are being considered for an assignment, the jobs that they will be considered for, and the skill development needs of each officer. The resource managers then scores each officer for each job and runs an assignment model to determine which officer to assign to which job.

REPRESENTATIONS: The menu displays 4 options open to the resource manager. While the sequence involved is sequential, the resource manager is given the flexibility to perform part of the sequence, save the data, and return to it at a later time.

OPERATIONS: The first three options call dBase III Plus sort and subroutines. The last option runs the Assignment model.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then Enter.



Pull Down Menus/Options:

RANK	AFSC
1LT	2825
2LT	49XX
CAPT	8016
MAJ	8035
LtCOL	etc.

HELP

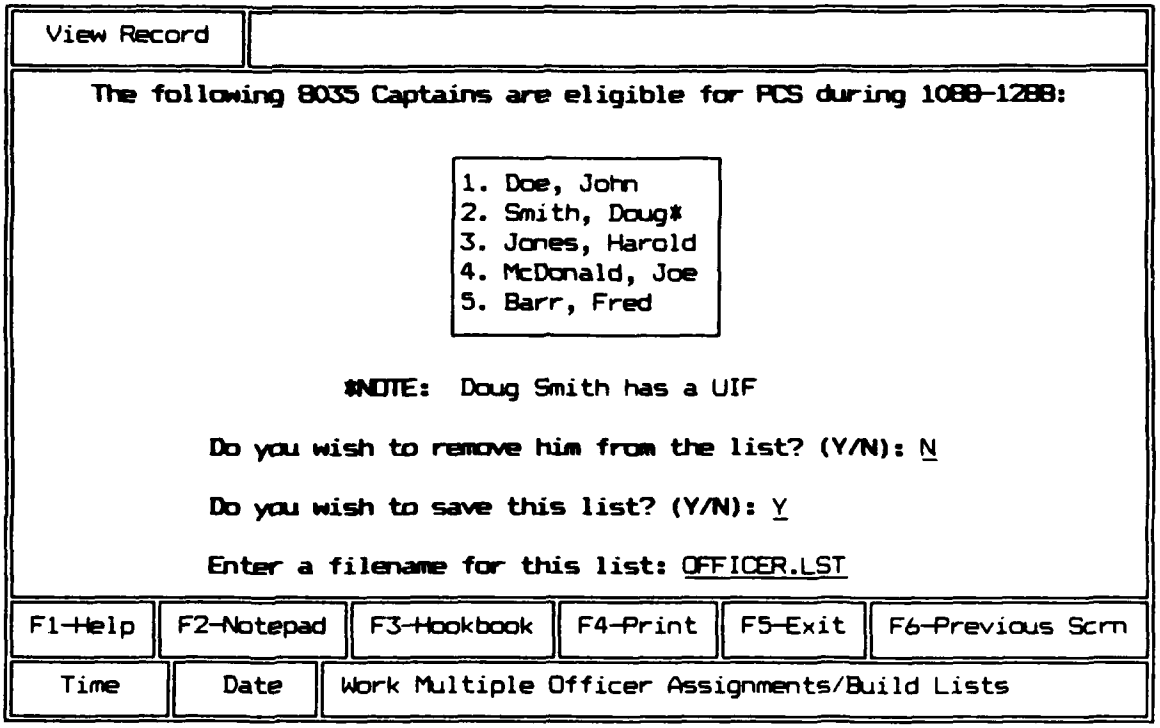
REQUIREMENTS: For the majority of cases, ESC Resource Managers are faced with assigning a pool of officers available for assignment to a pool of available jobs. They must be able to identify the pool of officers to be assigned by rank, AFSC, and a window of dates. They must also be able to identify the vacant job requirements by window dates.

REPRESENTATIONS: The resource manager is queried for information necessary to build a list of officers and jobs. Two menus are available to aid in the entry format.

OPERATIONS: The input data invokes two data sort routines: one in the officer data base and one in the job data base.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then **Enter**. A menu option is chosen by using the arrow keys and then **Enter**.



Window Option:

View Record: Same options as C-5

HELP

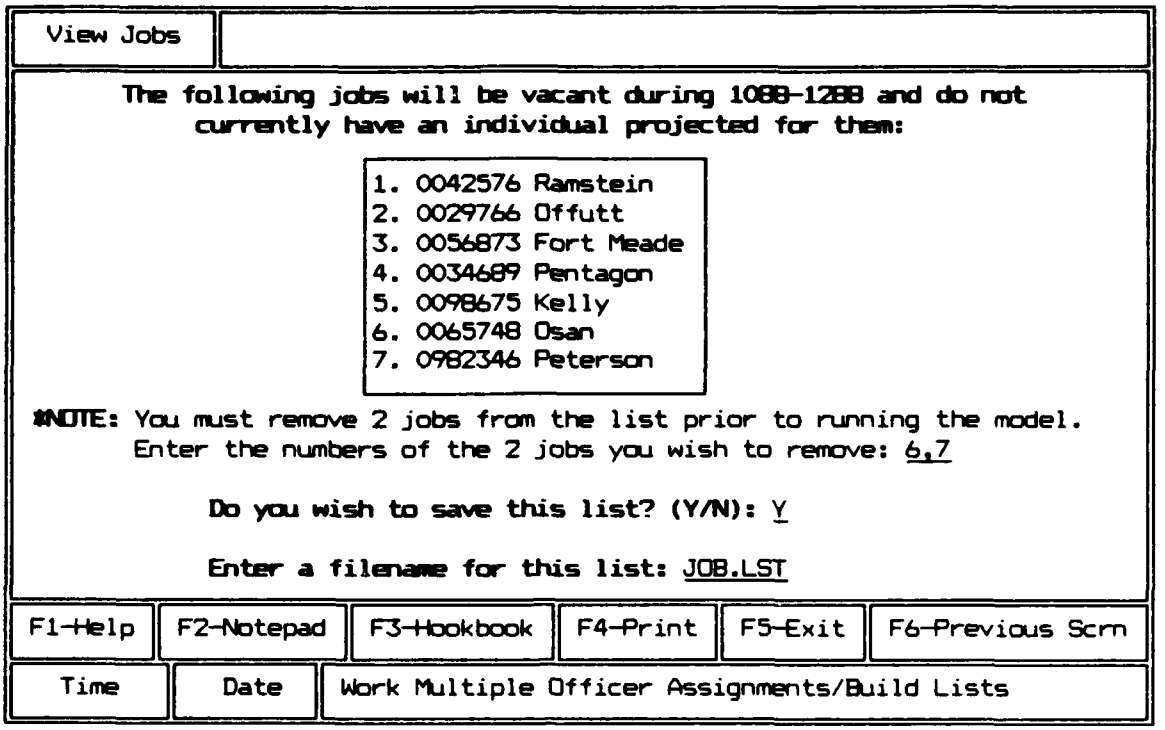
REQUIREMENTS: After the list of officers has been established, the ESC Resource Manager needs to know if there are any glaring problems in any of the officer's records or any special assignment considerations.

REPRESENTATIONS: The list of officers obtained by data sort is presented. Each officer's record is screened and an "*" appears by the name of any officer identified with a potential assignment problem. An explanation of the problem encountered appears at the bottom of the screen.

OPERATIONS: Each officer's record is screened using the data base screen record subroutine. The resource manager is given the option of removing an officer from the list. The view records window invokes a data base file retrieval for the officer of interest. The resource manager must save the list as a file for later use.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then Enter. A menu option is chosen by using the arrow keys and then Enter.



Window option:

View Jobs: Provides access to data base information

HELP

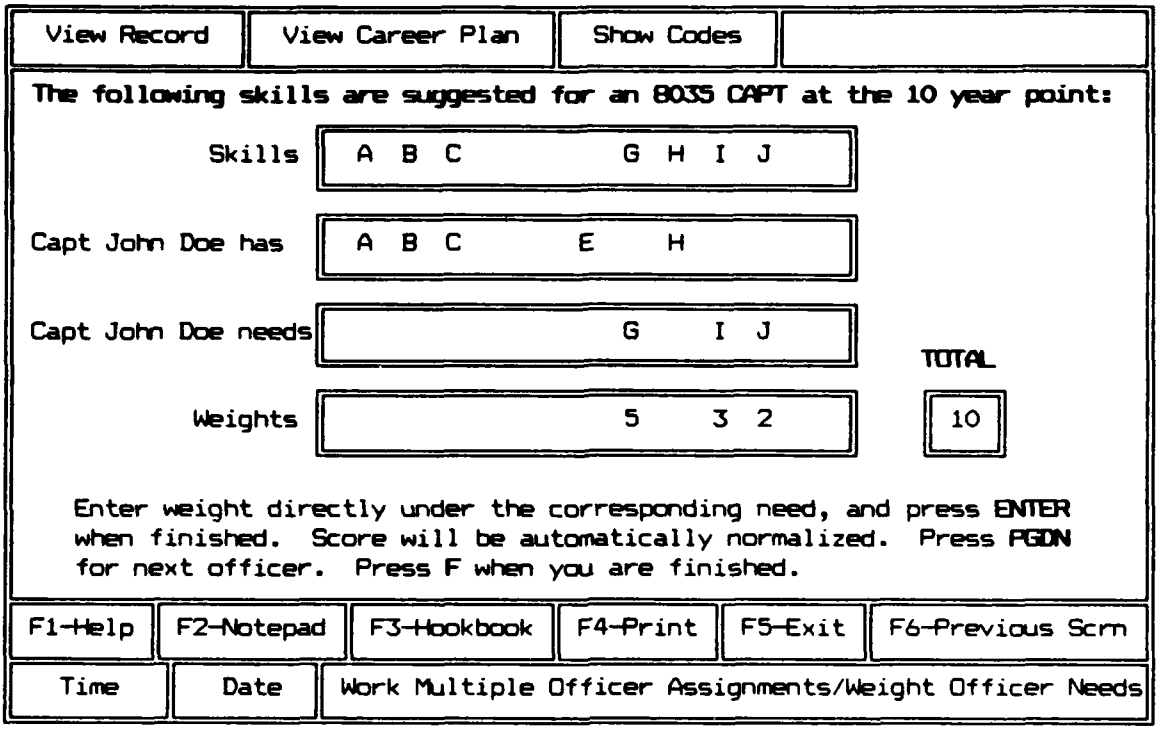
REQUIREMENTS: After the list of vacant jobs is sorted, the ESC Resource Manager must decide which jobs will be filled. Since ESC could not provide any guidelines for making a distinction between jobs, the resource manager must make a subjective assessment and reduce the number of jobs that will be filled equal to the number of officers being assigned.

REPRESENTATIONS: The list of jobs presented by data sort is presented.

OPERATIONS: The user can invoke a data base file retrieval to help in the decision of which jobs to eliminate. The resource manager must save the list as a file for later use.

MEMORY AIDS: Pull-down menus and function-key definitions

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then Enter. A menu option is chosen by using the arrow keys and then Enter.



Window Options:

View Record: Same options as C-5

View Career Plan: Provides career guidelines as in C-13

Show Codes: Provides a listing of requirement codes

HELP

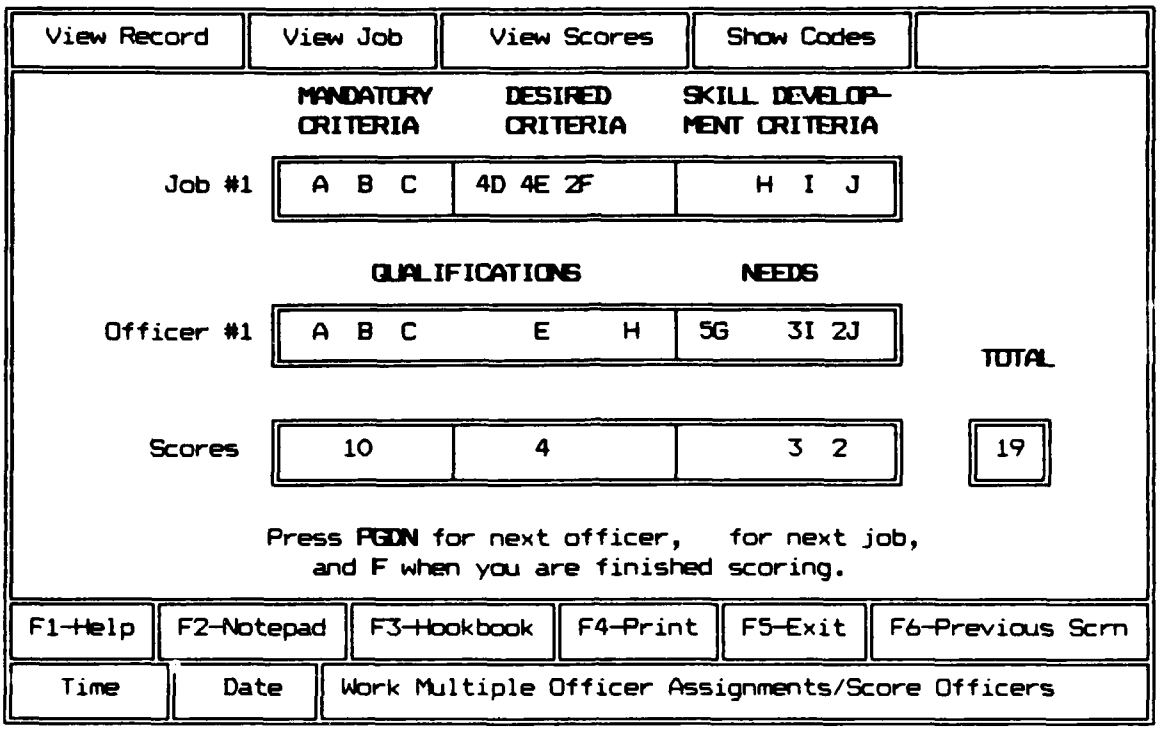
REQUIREMENTS: After the lists of officers to be assigned and available jobs are established, the ESC Resource Manager must assess each officer's ESC career development needs. This process involves identifying what skills an officer needs to develop for future ESC assignments and weight the importance of each of those skills.

REPRESENTATIONS: Assuming that an ESC career plan existed, a list of suggested skills would exist for various steps along the career progression. The top block on this screen represents suggested skill needs for the officers being considered for assignment. An officer's present skills and qualifications are presented in the second block. The difference between the top two blocks comprises the officer's skill development needs. The relative importance of each factor is indicated by numerical weights entered by the resource manager.

OPERATIONS: The resource manager weights the importance of each officer's skill development needs by placing a relative weight beneath each factor. Upon hitting the enter key, the factor weights will automatically be normalized an established number. For purposes of this example, the sum of skill development weights is 10. The needs and weights are also automatically stored in the officer's data base file.

MEMORY AIDS: Pull-down menus and function-key definitions. The user can recall an officer's record, or the ESC career plan. An explanation of the codes is available through the Show Codes option.

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then **Enter**. A menu option is chosen by using the arrow keys and then **Enter**. **PGDN** is used to move through the list of officers. **F** returns the user to the Work Multiple Officer Assignments Menu when all officer skill development needs have been identified and weighted.



Window Options:

View Scores:

Officers \ Jobs	1	2	3	4	...	15
1	10	13	15	17	...	24
2	25	0	23	30	...	19
3	15	30	25	10	...	15
4	10	23	0	21	...	13
.	.	.	.	.	.	.
.	.	.	.	.	.	.
15	14	17	20	22	...	11

Show Codes: Provides a listing of requirement codes

HELP

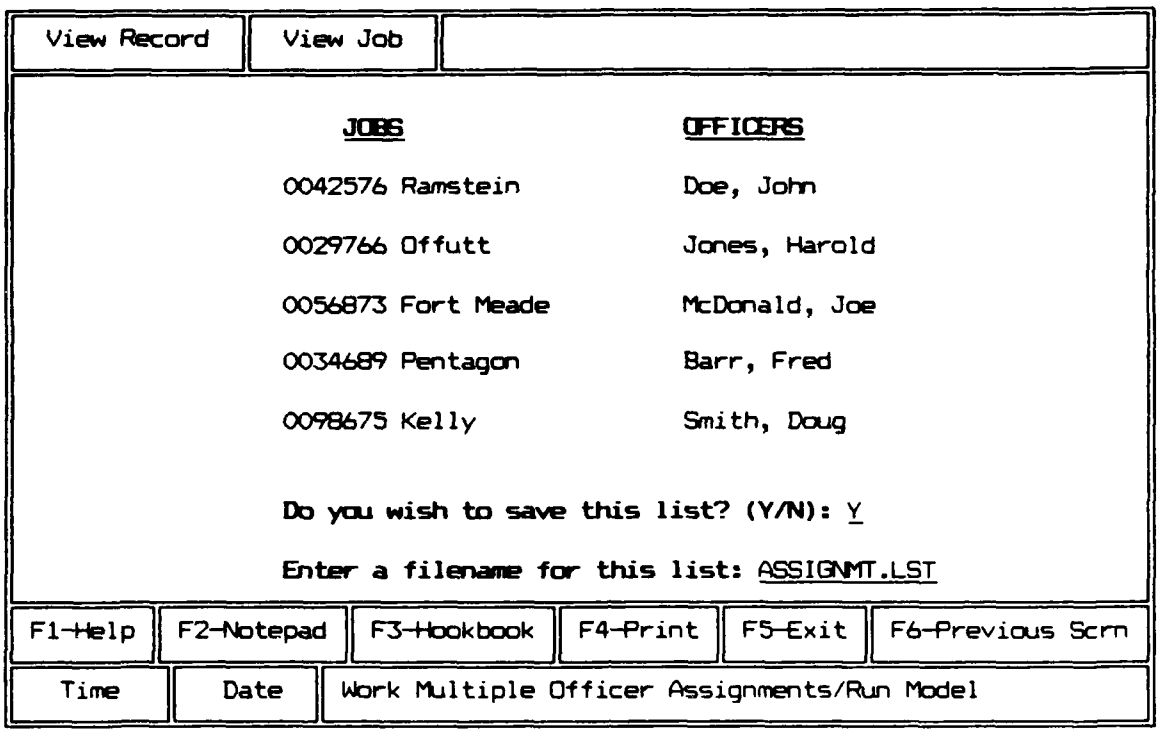
REQUIREMENTS: After the lists of officers to be assigned and available jobs are established and officer skill development needs have been weighted, the ESC Resource Manager must assess each officer's qualifications for each job.

REPRESENTATIONS: A single officer's qualifications are assessed against the requirements of a single job. The officer's qualifications are fields from the officer's data base record. The mandatory factors are those factors necessary for an officer to be assigned to that particular job. The desired factors are those qualifications that would be possessed by the ideal job candidate. The relative importance of each factor is indicated by numerical weights preceding each factor. The skill development factors are those skills that an officer will develop if assigned to the job. The third row is a work space for the resource manager to enter scores. The scores are totaled in the last block.

OPERATIONS: The user is building a score matrix as shown in the view scores option. The user may score each officer for one job and then move on to the next job, or vice versa. If an officer does not meet the mandatory criteria, a "0" is entered for the total score, otherwise a "10" is entered. For the desired criteria, the candidate receives the factor weights of the qualifications that he/she possesses. For the skill development criteria, the candidate receives the factor weights for the skills that a job offers and he/she needs. The maximum total score is 30.

MEMORY AIDS: Pull-down menus and function-key definitions. The user can recall an officer's record, or a job file. An explanation of the codes is available through the Show Codes option. The view scores helps the user keep track of who has been scored for what.

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then **Enter**. A menu option is chosen by using the arrow keys and then **Enter**. **PGDN** is used to move through the list of officers, and is used to move through the list of jobs. F returns the user to the Work Multiple Officer Assignments Menu when all officer skill development needs have been identified and weighted.



Window Options:

View Record: Same options as C-5

View Jobs: Provides access to data base information

HELP

REQUIREMENTS: The final requirement is a list of jobs and who the best choice is for each.

REPRESENTATIONS: Parallel listing of the best officer choice for each job.

OPERATIONS: The data is the output from the assignments model. One possible approach identified was to dump the score matrix to a spreadsheet, use a linear programming package to solve the problem, and send the solution back to dBase III Plus via the spreadsheet.

MEMORY AIDS: Pull-down menus and function-key definitions. The user can recall an officer's record, or a job file.

CONTROL MECHANISMS: Mouse or keyboard control. For keyboard control, select an option by using arrow keys and then Enter. A menu option is chosen by using the arrow keys and then Enter.

APPENDIX D

HOOKBOOK

This appendix identifies capabilities that must be developed in order to build the DSS described by the storyboards in Appendix C. It also identifies additional capabilities not shown in Appendix C that could be included in the DSS design or added later after an initial kernel system is built. As ideas came to mind, they were documented on index cards and later transferred to the computerized cards shown in this appendix.

DATE: 25 April 88	SUBJECT: Career Plan
IDEA: ESC needs to develop a career plan for each of the primary officer AFSC's within ESC. This career plan may resemble AFR 36-23 with ESC specific data entries. These guidelines need to be established in order to provide a baseline to measure an individual's career progression.	
CIRCUMSTANCE: Considering career evaluation techniques during literature review for thesis proposal	

DATE: 7 May 88	SUBJECT: Career Plan
IDEA: Using an ESC career planning guide, develop the capability of maintaining an individualized career plan on each officer. This plan could be updated as part of a counseling session with the officer's supervisor and/or resource manager.	
CIRCUMSTANCE: Reflecting on differences in Air Force and Navy career management policies and lack of ESC career guidelines.	

DATE: 21 May 88	SUBJECT: Career Plan
IDEA: Need to incorporate the JSO criteria into an officer's career plan if any ESC officers are going to make flag rank. Also, need to consider that some 26XX - 28XX individuals may be on a career broadening assignment from AFSC and be following the AFSC acquisition manager career development plan.	
CIRCUMSTANCE: Reviewing AFOAM model during literature review and discussing JSO considerations with Capt Weaver.	

DATE: 3 May 88	SUBJECT: Data Base, Jobs
IDEA: Integrate a list of jobs outside ESC that would enhance ESC job skills. These assignments would be "career broadening" for ESC, and officer would hopefully return to ESC on following tour. ESC should investigate the possibility of developing a program that would do just this and require the officer's return.	
CIRCUMSTANCE: Personal interview with Capt Washborn. Questions about developing experience such space operations.	

DATE: 12 May 88	SUBJECT: Data Base, Jobs
IDEA: Provide officers in ESC with access to job data base so Form 90 inputs are job specific. The assignment model could then be set up to sort through the officer's preferences by specific jobs. This data could be in the form of a floppy disc provided to units and include a job description for each job as well as a point of contact.	
CIRCUMSTANCE: Bouncing the DSS class example of an automated FM 90 system including detailed job descriptions off Capt Chubb.	

DATE: 4 August 88	SUBJECT: Data Base, Jobs
IDEA: ESC needs to establish requirements for each assignment. These requirements should probably be in the form of mandatory criteria, desirable criteria, and experience that an officer will gain in the job. A comprehensive list of all job requirements forms the basis of what experience factors need to be tracked for each officer.	
CIRCUMSTANCE: Follow-up visit to ESC. Discussions with DPQ personnel on their plans to acquire job requirement data	

DATE: 4 August 88	SUBJECT: Data Base, Jobs
IDEA: ESC needs to determine a method for keeping the data base current. After an initial survey establishes the baseline for all ESC officer job requirements, the burden for any changes should be placed on each supervisor. Updates could be made in the form of each unit providing floppy disks to ESC on a periodic basis.	
CIRCUMSTANCE: Follow-up visit to ESC. Discussions with DPQ personnel on their plans to acquire job requirement data	

DATE: 15 October 88	SUBJECT: Data Base, Jobs
IDEA: After job descriptions have been elicited from ESC units, consideration should be given to indexing jobs by key words in the description. This could be advantageous for resource managers and officers that wish to use the data base to look for a particular type of job.	
CIRCUMSTANCE: Feedback provided by LtCol Valusek during a thesis draft review.	

DATE: 3 May 88	SUBJECT: Data Base, Officer
IDEA: Find a way to incorporate the reverse side AF Form 90 comments. ESC could set a policy that these comments be put in bullet form for ease in entering in the data base. Additionally, front side Fm 90 career objectives are not part of the PDS and should be added as well.	
CIRCUMSTANCE: Personal interview with Capt Washborn. Discussion about which portions of FM 90 are computerized.	

DATE: 14 June 88	SUBJECT: Data Base, Officer
IDEA: Need to identify officer qualifications in terms of job requirements. SEIs are used extensively for enlisted personnel, but officers have very few if any. Limited information is available in the PDS so a local coding system will be necessary to identify those experiences.	
CIRCUMSTANCE: Information obtained from DPQ personnel on ESC trip.	

DATE: 4 August 88	SUBJECT: Data Base, Officer
IDEA: Consideration must be given as to how the officer data base will be kept current. Since ESC is devising a local coding scheme for officer skills and experiences, the monthly PDS dumps will not update these entries. The particular methodology will probably depend on the types of skills and experiences being tracked.	
CIRCUMSTANCE: Follow-up visit to ESC. Discussions with DPQ personnel on their plans to enter officer skills and experience data.	

DATE: 1 September 88	SUBJECT: Dialog
IDEA: Consideration should be given to using a DSS generator in lieu of trying to combine off-the-shelf software packages. Contact should be made with HQ USAF, DCS/Personnel since they conducted an extensive study on DSS generators for the Enlisted Force Management system.	
CIRCUMSTANCE: Frustration from trying to use dBase III Plus, VP Planner Plus, MS Windows, etc. to build a kernel DSS.	

DATE: 25 April 88	SUBJECT: Models, Assignment
IDEA: If it is desired to merely select the "best" officer for each job based on officer qualifications and job requirements, a simple linear programming assignments model or perhaps a spreadsheet model would suffice.	
CIRCUMSTANCE: Looking for possible modeling techniques while performing literature review for thesis proposal.	

DATE: 3 May 88	SUBJECT: Models, Assignment
IDEA: With the current reduction of PCS funds, lengthening of PCS tours, and greater number of PCA tours, a goal programming or multi-criteria model could be used to consider PCS costs and PCA assignments in addition to officer qualifications and skill development needs.	
CIRCUMSTANCE: Personal interview with Capt Washborn. Discussion on measures to maximize career development needs w/PCS fund cuts.	

DATE: 3 May 88	SUBJECT: Models, Assignment
IDEA: Integrate by-name requests as an input to a multi-criteria model. A central bank of officer resumes could be maintained on floppy discs and be made available to each unit. Units then could take on a more active role in choosing the "best qualified" officers for vacant jobs as well as doing some long range possibility planning	
CIRCUMSTANCE: Personal interview with Capt Washborn. Discussion about the usefulness/nuisance of the by-name requests.	

DATE: 5 August 88	SUBJECT: Models, Assignment
IDEA: Current assignment decisions are made based on moving an officer when AAD or DEROS dictates. This limits what jobs are available during the PCS window. Consideration should be given to adding a capability to the DSS that considers the benefit of moving an officer early or extending a tour to achieve a better experience match.	
CIRCUMSTANCE: Discussions with ESC personnel during follow-up visit	

DATE: 23 August 88	SUBJECT: Models, Assignment
IDEA: A multi-criteria model that incorporates AF career development needs, Form 90 desires, future force requirements, etc. could be developed in lieu of the linear programming assignments model if ESC would like to incorporate additional criteria in the assignments decision process.	
CIRCUMSTANCE: Discussions with LtCol Valusek on adapting a scoring model for use in the thesis	

DATE: 15 June 88	SUBJECT: Models, Assignment
IDEA: Incorporate additional criteria in the assignments model that considers the promotion impact of an assignment. The impact of the new OES also needs to be evaluated. A commander may "stove-pipe" an individual to utilize the officer's expertise and still protect his/her career by giving a "definitely promote."	
CIRCUMSTANCE: Discussions with Capt McCurdy and Capt Chubb during ESC visit concerning the trade off of experience vrs. career needs.	

DATE: 16 May 88	SUBJECT: Models, Rule-based
IDEA: Develop an rule-based model that makes assignment recommendations based on an officer's career needs, the officer's career objectives, AF career guidelines, and an ESC career plan.	
CIRCUMSTANCE: Considering possible models during literature review for thesis proposal.	

APPENDIX E

SURVEY

This appendix presents a survey that could be used to elicit the job requirements identified in Chapter V. The information provided in this appendix would need to be appended to a letter from ESC Headquarters mandating the accomplishment of such a survey. Additionally, the generic examples should be changed to ones more specific to ESC.

NAME: Doe, John T. **RANK**: CAPT **AFSC**: 8035 **POSITION #**: XXXXXX

Dear Supervisor:

ESC is currently building a data base of officer job position requirements. These requirements will be used for three important purposes: 1) to help resource managers fill job positions with officers that have the skills and experience required by each job; 2) to help ESC develop a career development plan for ESC officers; and 3) to help ESC manage officer training and skill development to insure there is a pool of well-qualified officers to meet the future force requirements of ESC.

The officer listed at the top of this page is currently filling the job position listed there as well. You, as his supervisor, are in the best position for determining what officer qualifications are necessary to fill this position. Since the information that you provide in this survey will be used to evaluate future candidates for this position, it is in your best interest to carefully consider your answers to the following questions.

STEP I. Identifying Mandatory Criteria Factors:

Mandatory Criteria are those minimum qualifications needed by an officer to perform the responsibilities of a job position. The current mandatory criteria are the rank and AFSC listed at the top of this page. Are there any additional qualifications that are absolutely essential for an officer to possess prior to being assigned to this position? You should be aware that any additional requirements will narrow the field of possible job candidates, and over-specifying mandatory criteria may result in the position not being filled. Examples of qualifications you may want to consider are provided in the left-hand column below. Fill in any Mandatory Criteria in the right-hand column.

EXAMPLES	MANDATORY CRITERIA
Advanced Degree:	_____
Training Schools:	_____
Job Skills:	_____
Technical Skills:	_____
Job Experience:	_____
Supervisor Experience:	_____
Etc.	_____

STEP II. Identifying Desired Criteria:

Desired Criteria are the officer qualifications that an ideal job candidate would possess. These criteria will be used by the resource managers to try, whenever possible, to place a "better qualified" officer in this job position. What additional qualifications would you like to see in a job candidate being considered for this position? Examples of qualifications you may want to consider are degree specialty area, secondary AFSC, previous job experience, previous work experience, military background and expertise, etc. List these criteria in Column A below.

STEP III. Rank order your list of factors in the following manner:

Look at the list in Column A and pick out the most important factor. Place this item on line 1 of Column B. Next, pick out the second most important factor and place it on line 2. Continue ordering all factors until Column B consists of all factors listed from most important to least important.

STEP IV. Weight the importance of each factor relative to the least important factor in the following manner:

Place a "1" in the Weights column adjacent to the <u>least</u> important factor in Column B. Next, compare each of the remaining factors in Column B to the least important factor. Enter a weight of how much more important each factor is than the least important factor.

For example: If your least important factor is "has been a section chief" and another factor is "has been to JOCCP" and in your judgement having JOCCP is twice as important as having been a section chief, you would place a "2" in the weights column adjacent to the "has been to JOCCP."

Column A	Column B	Weights
_____	_____	____
_____	_____	____
_____	_____	____
_____	_____	____
_____	_____	____
_____	_____	____
_____	_____	____
_____	_____	____

STEP V. Identifying Skill Development Opportunities:

In addition to finding "the best qualified" officers to fill jobs, ESC is also interested in identifying what skills and experiences an officer will develop over the course of a 3-4 year tour in this position. In particular, what skills and experiences can an officer expect to gain in this job that will be of benefit for his/her career and/or future ESC jobs? Examples of qualifications you may want to consider are provided in the left-hand column below. Fill in any Skill Development Criteria in the right-hand column.

EXAMPLES	SKILL DEVELOPMENT CRITERIA
Training Schools:	_____
Job Skills:	_____
Technical Skills:	_____
Job Experience:	_____
Supervisor Experience:	_____
Etc.	_____

STEP VI. Composing a Brief Job Description:

Finally, ESC is also comprising a short job description of each job position within the data base. These job descriptions will be used to provide resource managers with a better understanding of the job requirements they are trying to fill. Additionally, these descriptions will eventually be consolidated and made available to all ESC units for officers to use in filling out their Form 90 preferences. The description can be no more than 5 type-written lines. One possible suggestion would be to condense the job description from block III of the last OER you wrote for the officer presently in the position. Also provide the name and number of a point of contact who would be able to answer any questions about the job.

JOB DESCRIPTION:

_____
_____
_____
_____
_____

POINT OF CONTACT:_____ AUTOVON NUMBER _____

Thank you for your cooperation in this endeavor.

APPENDIX F

MULTIPLE-CRITERIA MODELS

This appendix presents the techniques of point estimate weighted-sums and goal programming as possible alternate approaches for developing a model for use by resource managers in making officer assignment decisions. Minch and Sander's article would provide good background reading should ESC wish to incorporate a multicriteria model in their DSS.

Background

There are two general approaches to multiple-criteria decision making (MCDM): 1) Multi-attribute decision analysis (MADA), which "is the descriptive version of MCDM"; and 2) Multi-criteria optimization (MCO) which "is the prescriptive version of MCDM" (Chan, 1988). MCDA is a "process-oriented approach" which seeks to answer the question "how" whereas MCO is an "outcome-oriented approach" which seeks to answer the questions "what and when" (Zeleny, 1982:85). MCDA has been most applicable to resolving "problems with a small number of alternatives in an environment of uncertainty" such as those involving public policy decisions (where to build a nuclear power plant, where to build a new airport, etc.) MCO is more useful when applied to less controversial "deterministic problems in which the number of feasible alternatives is large" such as business decisions involving staffing, budgeting, production, resource management, etc. (Steuer, 1986:5). Since ESC is primarily interested in answering the "what and when" questions involved in officer resource management, a MCO approach is used in this appendix. Should ESC desire more information on MCDA, Kenney and Raiffa's text would be a good starting place.

Many MCDM techniques focus on a decision maker's utility function. In MCO, a mathematical expression of the decision maker's utility function is used to calculate an optimal solution. "The difficulty is that with many problems it is not possible to obtain a mathematical representation of the decision maker's utility function" (Steuer, 1986:4). In the case of ESC officer resource managers, each individual has a different utility curve which is subject to daily fluctuations due to the volatile nature of their decision-making environment. Since extraction of

each resource manager's utility function would be impossible, techniques that do not explicitly require the use of a mathematical utility function must be utilized.

Criteria

Before discussing possible modeling techniques, it will be useful to identify the set of objectives that will be used by resource managers when making officer assignment decisions. Since ESC is still in the process of identifying a set of objectives for the officer resource manager DSS, the following are some possible suggestions:

1. Maximize the immediate mission accomplishment by placing the best qualified officer in each job.
2. Maximize the future mission accomplishment by placing each officer in the job that best trains him/her for future ESC assignments.
3. Maximize officer promotion potential by placing each officer in the job that best fulfills Air Force career development guidelines.
4. Maximize officer retention and morale by assigning each officer to the job of their preference.

These objectives provide a basis for establishing measurable criteria for evaluating the accomplishment of objectives. The first two objectives were discussed at length within the main body of the thesis and were the basis for the three criteria developed in Chapter V. These three criteria are also used in this appendix; however, for purposes of discussing alternate modeling techniques, some changes were necessary as can be seen in Figures F.1 and F.2.

Comparing Figure F.1 with Figure 5.2, one will see that the mandatory criteria has been retitled "minimum criteria" and the minimum criteria factors have been weighted. These changes provide resource managers with the flexibility to assign an officer to a job position where

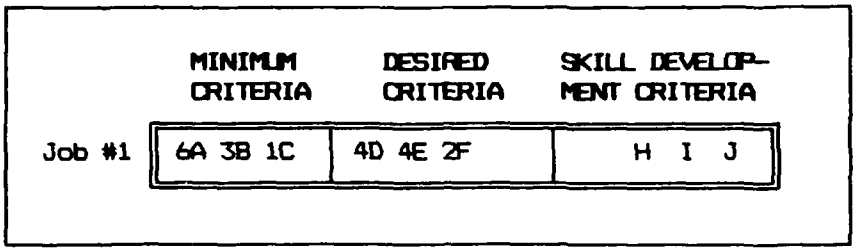


Figure F.1 Revised Job Criteria

he/she does not meet the minimum level of qualifications in certain extenuating circumstances. For instance, an officer may score well in all other criteria and the resource manager may feel that the officer has sufficient background to do well in the job despite missing one or more minimum criteria factors.

As shown in Figure F.2, the scoring of officers for jobs would be performed in the same manner as described in Chapter V with the exception that the criteria scores are not summed together. This approach will allow the resource manager to rank and/or weight criteria as the decision environment changes. As in Chapter V, the sum of each of the criteria factor weights are normalized to 10.

The third objective requires an assessment of each officer's career progress against an Air Force career standard. Although currently not available, a rule-based model could be developed that utilized AFR 36-20, AFR 36-23, and the "unwritten" MPC rules to assess an officer's overall Air Force career needs and score the officer for potential assignments based on these needs. For purposes of this appendix, it is assumed that such a model does exist and officers are scored for each job on a scale from 0 to 10.

The last objective requires the elicitation of each officer's job

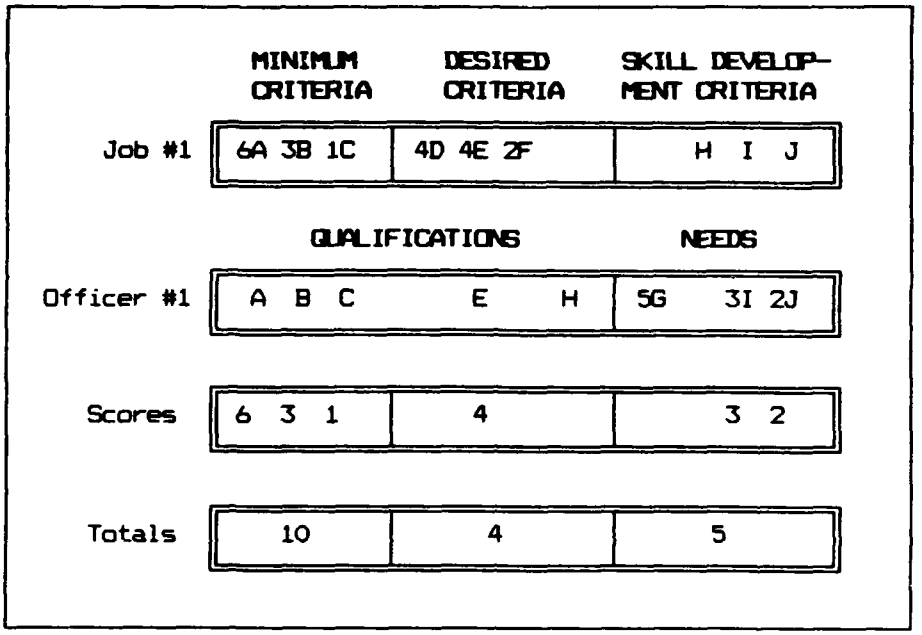


Figure F.2 Revised Scoring Method

preferences. Although it would probably be better to obtain this information by a written survey, time constraints would most likely dictate the use of a phone survey. An officer could be asked to rank each potential assignment on a scale from 0 to 10, with "10" representing the most preferred assignment and "0" the least preferred.

These five criteria provide a means of measuring the accomplishment of the four suggested objectives. Each officer being considered for an assignment would be evaluated for each available job position in terms of these five criteria. The final result of this process would be 5 scores for each officer for each job (on the scale of 0 to 10). Figure F.3 provides an example of one officer scored for one job.

MCO Techniques

The most promising solution techniques would appear to be point estimate weighted-sums and goal programming.

MINIMUM CRITERIA	DESIRED CRITERIA	SKILL DEVELOP-MENT CRITERIA	AIR FORCE CAREER	OFFICER'S PREFERENCE
10	4	5	7	8

Figure F.3 Officer #1 Scores for Job #1

Point Estimate Weighted-Sums. Similar to the formulation presented in Chapter V, the point estimate weighted-sums approach utilizes a linear programming format. A single objective function is formed by summing the products of each criteria and a scalar weighting function. The advantage of such an approach is that an explicit utility function does not have to be determined. Each time a group of officer assignments are to be made, the resource manager would assign weights to the five criteria based on his/her subjective judgement. Assuming the same assumptions from Chapter V, the following is a point-estimate weighted sums formulation:

Decision Variables:

X_{ij} = 1 if officer i is assigned to job j
0 otherwise

Parameters:

C_{kij} = The criteria k score of assigning officer i to job j

w_k = The scalar weight assigned to criteria k

Objective Function and Constraints:

MAXIMIZE: $$Z = \sum_{i=1}^{15} \sum_{j=1}^{15} \sum_{k=1}^{5} w_k C_{kij} X_{ij}$$ (Total sum of weighted criteria scores when officer i is assigned to job j)

$$\text{SUBJECT TO:} \quad \sum_{j=1}^{15} X_{ij} = 1 \quad \text{for } i = 1 \text{ to } 15 \quad \text{(Assign every officer to a job)}$$

$$\sum_{i=1}^{15} X_{ij} = 1 \quad \text{for } j = 1 \text{ to } 15 \quad \text{(Fill all jobs)}$$

$$X_{ij} = (0,1) \text{ for all } i,j \quad \text{(Solutions must be integer)}$$

Goal Programming

A goal programming approach differs from linear programming by:

1. The conceptualization of objectives as goals.
2. The assignment of priorities and/or weights to the achievement of goals.
3. The presence of deviation variables d_i^+ and d_i^- to measure overachievement and underachievement from target (or threshold) levels t_i.
4. The minimization of weighted-sums of deviation variables to find solutions that best satisfy the goals. (Steuer, 1986:282)

The objective in goal programming is to satisfice rather that optimize. "Satisficing is the process of eliminating alternatives with unacceptable attribute values" as opposed to optimization which seeks the "best" solution (Chan, 1988). Before employing the technique of goal programming, it is necessary to identify the decision maker's goals.

> Goal setting for satisficing solutions is defined as the procedure of identifying a satisficing set S such that, whenever the decision outcome is an element of S, the decision maker will be happy and satisfied and is assumed to have reached the optimal solution. (Yu, 1985:56)

Three types of goals are possible: 1) lower, one-sided; 2) upper, one-sided; and 3) two-sided. A resource manager using the five criteria suggested in this appendix to set goals would probably select all lower,

TABLE F.1

Nonpreemptive Goals and Priorities

Priority Level	Criteria	Goal	Criteria Weight
All Equal	Minimum	≥ 8	5
	Desired	≥ 5	4
	Skill Development	≥ 5	3
	Air Force Career	≥ 8	2
	Officer's Preference	≥ 5	1

one-sided goals. It is conceivable that ESC may decide to use additional criteria in the future such as total PCS cost, which would result in a upper one-sided goal, or maintaining a certain manning level at each unit, which would result in a two-sided goal.

Once a set of goals are established, the decision maker must decide on the relative importance of each goal. After ranking goals according to level of importance, and rating the relative importance of each goal, the decision maker must decide whether to consider all goals simultaneously or sequentially. There are two types of goal programming: 1) preemptive goal programming, "where there is a hierarchy of priority levels for the goals, so that the goals of primary importance receive first-priority attention, those of secondary importance receive second-priority attention, and so forth"; and 2) nonpreemptive goal programming, where "all of the goals are of roughly comparable importance" (Hillier, 1986:242).

For purposes of demonstrating these two methods, assume that a resource manager's preference is that of Table F.1. A non-preemptive goal programming formulation would be as follows:

Decision Variables:

X_{ij} = 1 if officer i is assigned to job j
0 otherwise

Parameters:

w_k = The scalar weight assigned to criteria k

C_{kij} = The criteria k score of assigning officer i to job j

D_{kj}^- D_{kj}^+ = The positive and negative deviations from criteria k goals in job j

G_{kj} = The desired criteria k goal for job j

Objective Function and Constraints:

MINIMIZE: $Z = \sum_{k=1}^{5} \sum_{j=1}^{15} w_k D_{kj}^-$ (Total sum of weighted negative deviations from criteria goals)

SUBJECT TO: $\sum_{j=1}^{15} X_{ij} = 1$ for i = 1 to 15 (Assign every officer to a job)

$\sum_{i=1}^{15} X_{ij} = 1$ for j = 1 to 15 (Fill all jobs)

$\sum_{i=1}^{15} C_{kij}X_{ij} + D_{kj}^- - D_{kj}^+ = G_{kj}$ for i = 1 to 15, for k = 1 to 5

(Officer score plus or minus some deviation must equal the goal of each criteria for each job)

X_{ij} = (0,1) for all i,j (Solutions must be integer)

Now, assume the resource manager prefers different priority levels for the criteria as shown in Table F.2. A preemptive formulation would be as follows:

TABLE F.2

Preemptive Goals and Priorities

Priority Level	Criteria	Goal	Criteria Weight
First Level	Minimum Criteria	≥ 8	4
	Desired Criteria	≥ 5	1
Second Level	Skill Development	≥ 5	3
	Air Force Career	≥ 8	2
Third Level	Officer's Preference	≥ 5	1

Decision Variables:

X_{ij} = 1 if officer i is assigned to job j
0 otherwise

Parameters:

w_k = The scalar weight assigned to criteria k

C_{kij} = The criteria k score of assigning officer i to job j

D_{kj}^- D_{kj}^+ = The positive and negative deviations from criteria k goals in job j

G_{kj} = The desired criteria k goal for job j

Objective Function and Constraints for First Priority Level:

MINIMIZE: $Z_1 = \sum_{k=1}^{2} \sum_{j=1}^{15} w_k D_{kj}^-$ (Total sum of weighted negative deviations from criteria 1 and 2 goals)

SUBJECT TO: $\sum_{j=1}^{15} X_{ij} = 1$ for i = 1 to 15 (Assign every officer to a job)

$\sum_{i=1}^{15} X_{ij} = 1$ for j = 1 to 15 (Fill all jobs)

$$\sum_{i=1}^{15} C_{kij}X_{ij} + D_{kj}^{-} - D_{kj}^{+} = G_{kj} \quad \text{for } i = 1 \text{ to } 15, \text{ for } k = 1,2$$

(Officer score plus or minus some deviation must equal the goal of criteria 1 and 2 for each job)

$X_{ij} = (0,1)$ for all i,j (Solutions must be integer)

Objective Function and Constraints for Second Priority Level:

MINIMIZE: $Z_2 = \sum_{k=1}^{2} \sum_{j=1}^{15} w_k D_{kj}^{-}$ (Total sum of weighted negative deviations from criteria 3 and 4 goals)

SUBJECT TO: $\sum_{j=1}^{15} X_{ij} = 1$ for $i = 1$ to 15 (Assign every officer to a job)

$$\sum_{i=1}^{15} X_{ij} = 1 \quad \text{for } j = 1 \text{ to } 15 \quad \text{(Fill all jobs)}$$

$$\sum_{i=1}^{15} C_{kij}X_{ij} + D_{kj}^{-} - D_{kj}^{+} = G_{kj} \quad \text{for } i = 1 \text{ to } 15, \text{ for } k = 3,4$$

(Officer score plus or minus some deviation must equal the goal of criteria 3 and 4 for each job)

$$\sum_{k=1}^{2} \sum_{j=1}^{15} w_k D_{kj}^{-} = Z_1$$

(Total sum of weighted negative deviations from criteria 1 and 2 goals not allowed to vary)

$X_{ij} = (0,1)$ for all i,j (Solutions must be integer)

Objective Function and Constraints for Third Priority Level:

MINIMIZE: $Z_3 = \sum_{j=1}^{15} w_5 D_{5j}^{-}$ (Total sum of weighted negative deviations from criteria 5 goals)

SUBJECT TO:

$$\sum_{j=1}^{15} X_{ij} = 1 \quad \text{for } i = 1 \text{ to } 15 \quad \text{(Assign every officer to a job)}$$

$$\sum_{i=1}^{15} X_{ij} = 1 \quad \text{for } j = 1 \text{ to } 15 \quad \text{(Fill all jobs)}$$

$$\sum_{i=1}^{15} C_{5ij}X_{ij} + D_{5j}^{-} - D_{5j}^{+} = G_{5j} \quad \text{for } i = 1 \text{ to } 15$$

(Officer score plus or minus some deviation must equal the goal of criteria 5 for each job)

$$\sum_{k=1}^{2} \sum_{j=1}^{15} w_k D_{kj}^{-} = Z_1$$

(Total sum of weighted negative deviations from criteria 1 and 2 goals not allowed to vary)

$$\sum_{k=3}^{4} \sum_{j=1}^{15} w_k D_{kj}^{-} = Z_2$$

(Total sum of weighted negative deviations from criteria 3 and 4 goals not allowed to vary)

$X_{ij} = (0,1)$ for all i,j (Solutions must be integer)

Conclusion

There are several modeling techniques that can be used for assigning officers to jobs. Each technique favors a particular decision making preference structure. Conceivably, if ESC gives each resource manager the freedom to choose his/her own preference structure for making officer assignments, the DSS model base could consist of all of the modeling techniques demonstrated in this appendix.

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VITA

Captain Richard A Paulsen was born [redacted] After graduating from Annapolis High School, he enrolled in the NROTC program at the University of Virginia. He received an NROTC appointment to the United States Naval Academy from which he graduated with a Bachelor of Science Degree in Electrical Engineering in June 1978. Upon graduation, he was commissioned as an ensign in the Navy, completed a year of naval nuclear power training, and was assigned to the USS Lafayette (SSBN 616) where he was awarded his Submarine Dolphins in March 1981. He passed the Naval Reactors Engineers Exam prior to his inter-service transfer to the Air Force in October 1983. During his initial Air Force assignment, he served as Section Chief of the Electromagnetic Pulse (EMP) Effects Section at the Air Force Weapons Laboratory (AFWL), Kirtland AFB, New Mexico, where he directed AFWL's Minuteman, Peacekeeper, and Small Missile EMP programs. In February 1984, he became the Technology Branch Chief, where he was responsible for AFWL's nuclear weapon environment prediction program (blast, thermal, radiation, and EMP) for aircraft and missile systems until entering the School of Engineering, Air Force Institute of Technology, in May 1987.

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Block 19 (cont)

This thesis presents a decision support system (DSS) design for the Electronic Security Command (ESC) officer resource managers. The DSS design provides resource managers with:

1. Quick access to officer and job data bases needed to support the numerous phone calls from officers seeking assignment information.

2. A computerized notepad for documenting phone conversations and other various pieces of information gathered on each officer.

3. A rule-based career model to evaluate an officer's career progression and offer assignment recommendations and career counseling advice.

4. A method for scoring officers for jobs based on each officer's qualifications and career development needs.

5. A linear programming assignment model which provides job assignment recommendations by maximizing the sum of officer job qualification scores.

The technique of concept mapping was used to bound the problem and elicit system requirements from ESC. A set of screen-display storyboards were constructed to communicate system requirements in the form of representations, operations, memory aids, and control mechanisms (ROMC). Methodologies for characterizing and eliciting job requirements, evaluating officer career needs, and evaluating officer qualifications for jobs were also developed. Goal programming and point estimate weighted-sums models were also presented as possible alternatives for an assignments model.

This thesis laid the foundation of requirements determination, methodology development, system design, and model formulation upon which ESC can now begin building a DSS that will help resource managers make officer assignment decisions based on the "best qualified" officers for each job, while also considering the career development needs of each officer and the future force requirements of ESC.